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SEQUENTIAL PROBABILITY RATIO TESTS OF THE SCALE PARAMETER BETWEEN TWO WEIBULL DISTRIBUTIONS WITH KNOWN SHAPE PARAMETER

THESIS

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SEQUENTIAL PROBABILITY RATIO TESTS OF THE SCALE PARAMETER BETWEEN TWO WEIBULL DISTRIBUTIONS WITH KNOWN SHAPE PARAMETER.

9 Master's

THESIS,

Presented to the Faculty of the School of Engineering

of the Air Force Institute of Technology

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in Partial Fulfillment of the

Requirements for the Degree of

Master of Science

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Preface

In recent years considerable progress has been made in developing sequential methods for testing Weibull distributed populations. This thesis represents a continuation of previous work in that area. It is hoped that the test plans and evaluations presented here will provide a viable testing alternative to using fixed sample Weibull test plans in future reliability programs.

The behavior of Weibull sequential probability ratio tests has been an extremely interesting topic of study. I would like to thank Dr. Albert H. Moore for suggesting it, and for helping me with the development. I would also like to thank Major Charles W. McNichols, my reader, for his help with both computer programming and preparing the manuscript. Finally, thanks to Dr. H. Leon Harter of the Air Force Flight Dynamics Laboratory for sponsoring this effort.

I have tried to present my results in complete and understandable form. I am fully responsible for any errors.

James N. Robinson

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n: The number of test units placed on test without replacement in a SPRT specifying a dependent sample configuration.

n': The number of test stands in operation for any SPRT configuration. (In the computer programs, n'=NSTAND.)

r: A failure number of interest in a SPRT which indicates a decision point in the test. $E_\theta[r]$ is the expected number of failures prior to an accept or reject decision when θ is the true parameter of the population being tested.

t: The elapsed clock time in a SPRT. $E_\theta[t]$ indicates the expected clock time to an accept or reject decision in a SPRT when θ is the true parameter value.

V(t): The value of a test statistic in a Weibull (or exponential) SPRT at a given clock time t. This statistic may be evaluated continuously or after each failure (discretely).

$x_{r,n}$: The life length, expressed as a random variable, of the rth out of n units. An order statistic.

$\Gamma(1+1/k)$: The mathematical gamma function of the argument $(1+1/k)$.

Abstract

Three types of Weibull sequential probability ratio tests between specified scale parameters are examined when the shape parameter of the distribution is assumed known. The three types of testing are: one test unit tested at a time with replacement on failure, n units on test without replacement (dependent sample), and n' units on test with replacement on failure. A new test statistic is presented for the third type. Truncated test plans representing 40 possible shape parameters ranging from .50 to 5.70 are presented for four sets of designated risks. Designated risks for equal Type I and Type II errors are .05, .10, .20, and .30. Monte Carlo computer simulations are used to evaluate the test plans in terms of actual risks and actual expected time and failure number to decision under H_0 and H_A.

Basic equivalence of test configurations is demonstrated in terms of expected true risk and failure number. Increased discrimination capability is also demonstrated as shape parameter values increase.

A cost model which can be used to determine which testing configuration to use under different testing restrictions is offered. Two examples are presented to illustrate application of Weibull SPRT's under cost restraints.

I. Introduction

Brief Background

The growing dependence of soceity on an environment shaped by technology requires parallel growth in the area of reliability control. As tolerances for error decrease in increasingly complex systems, quality control methods used to judge the reliability of subcomponents must improve. The search for accurate and efficient tests for quality assurance must keep pace with the demands of technology. New test methods which are efficient and easy to use should continue to be developed.

The sequential probability ratio test adapted for use with the Weibull distribution is a comparatively new testing tool which has been developed during the current decade. This test is particularly well suited to tests of hypotheses involving time to failure in reliability testing. Since the Weibull distribution is extremely flexible, these tests can be used in testing a wide range of populations. The purpose of this thesis is to further develop sequential tests for use with this distribution.

There are significant parallels between Weibull sequential tests and exponential sequential tests. In truth, the exponential case is a subset of Weibull testing. Sequential tests between scale parameters when the shape parameter is known have been constructed for the Weibull by previous

researchers (Ref 1) (Ref 2) (Ref 3). To this date, sequential procedures have been developed for two types of Weibull testing. These types are for configurations when one item is tested at a time with replacement, or when a dependent sample of some specified size is tested all at once without replacement.

Central Premise

It can be assumed that a third type of testing applies for Weibull sequential tests. Because of the parallels between exponential and Weibull testing, it can be hypothesized that any number of items can be placed on test simultaneously. If these items are replaced after failure, a third test type, independent testing, can be conducted using the same test boundaries which are used for the previous two types. The basic hypothesis of this thesis is that regardless of the testing configuration for Weibull sequential tests, the same testing boundaries can be used. Minor modifications in a test statistic can compensate for the differences in test configurations. It is believed there are certain equivalent aspects of behavior for Weibull test configurations exactly as there are for exponential tests.

The author presents numerous truncated sequential test plans in the appendices. These plans are evaluated using Monte Carlo computer simulations. Simulation is used as a means of illustrating equivalence between different sequential test configurations. The test plans are presented

as an extension of previous work by Williams (Ref 4) in an effort to provide the potential user with a number of plans with evaluated risk alternatives to be used for a variety of testing situations.

A basis for equivalence appears to be established between different testing configurations for the Weibull tests presented. For that reason, the author intends to clarify the decision regarding the best test configurations to employ for a variety of testing situations. It is believed that a discussion of the best test configuration to use in sequential Weibull testing will prove helpful to anyone wishing to use the prepared test plans. Such a discussion can be presented with the aid of relatively simple cost models.

Organization

This thesis contains considerable background information. Much of the information presented is prepared for the individual who is somewhat unfamiliar with either sequential tests or the Weibull distribution. Chapter II is used to discuss the concept of a sequential test. Chapter III is a full discussion of the Weibull distribution. Chapter IV presents the construction of Weibull sequential tests. Chapter V describes the rationale behind the test plan sets presented in the appendices. In Chapter VI, the role of the computer in thesis preparation is discussed. That role was major. This chapter presents a general discussion of how the computer programs work and the meaning of the output.

Chapter VII is a presentation of the results of computer simulations. An illustration of equivalence between cases of testing is offered. Chapter VIII contains a cost model for evaluating an optimum test configuration. Two examples of testing situations are presented. The conclusion is in Chapter IX. An extensive set of appendices follows the body of the thesis. The first eight appendices alternate between evaluations and test plans paired by designated risk level. The three computer programs used are presented in Appendix I.

II. The Sequential Probability Ratio Test

According to Ghosh, "Sequential analysis is concerned with the statistical treatment of observational data whose final size and composition are not predetermined but depend, in some specified way, on the data themselves [Ref 5:vii]." This succinct statement describes a broad range of statistical tests which have been developed since the initial statements on the theory developed by Abraham Wald and published in Sequential Analysis in 1947 (Ref 6).

The purpose of this section is not to develop the proofs behind the sequential probability ratio test (SPRT), but to clarify some of the philosophy behind the use of the test. Some of the major formulas developed by Wald will be presented. These formulas will help to clarify test mechanics in the reader's mind. For those who desire more elaborate treatment, the author highly recommends Wald's original work or one of the other descriptions available; notably, those by Weatherill (Ref 7) or Mood and Graybill (Ref 8).

Since this paper is primarily oriented toward a potential user of standard tests, there are three major areas of importance which will be discussed. A general background and philosophy section will give a basic idea of how sequential tests developed. A formula section will identify and clarify "need to know" formulas. A final

section will briefly cover the actual employment of sequential tests.

Background

In using any statistical test, the basis of the philosophy behind the test should be understood by the user in order to apply the test for its best performance. In the following discussion, the reader may find it helpful to refer to Fig. 1 which has been taken from Freund (Ref 9:239).

The probability of making a Type I error is commonly referred to as the alpha error (α) and the probability of making a Type II error is termed the beta error (β). Alpha error might be further classified as the consumers' risk or the probability of accepting a bad lot, where beta error is commonly called the producers' risk or believing that a good lot is defective. In Wald's discussion, our of "m" statements about a population, based on test statistics, some will

	H_0 is true	H_A is true
ACCEPT $H_)$	correct decision	Type II error
ACCEPT H_A	Type I error	correct decision

Fig. 1. Possibilities in Statistical Hypothesis Tests (Ref 9:239)

be in error, and in the long run the error amounts to the alpha and beta errors of the test as "m" gets large (Ref 6: 17). For a fixed sample test, where the number of samples (from which a test statistic is derived) is some fixed constant n, the best test is one which has the smallest alpha and beta errors for a given n (Ref 6:17). Neyman and Pearson have shown that the most powerful critical region for simple hypotheses (one that provides smallest β for fixed α) is determined by a likelihood ratio (Ref 6:18) (Ref 10).

$$\frac{f_1(x_1)r_1(x_2)\ldots f_1(x_n)}{f_0(x_1)f_0(x_2)\ldots f_0(x_n)} \geq k \qquad (2.1)$$

$f_1(x_1)$ = pdf evaluated under H_A

$f_0(x_1)$ = pdf evaluated under H_0

k = arbitrary constant for fixed α

One might envision a rejection region for a statistic, y, which is chi-square distributed. Fig. 2 describes such a critical region for a simple hypothesis. One might further imagine that the critical region is best in a Neyman Pearson sense. The "y" in this case would be a test statistic determined by the likelihocd ratio. For any fixed sample size n, if the value of the test statistic y falls to the right of a line determined by k, H_0 is rejected.

A test Wald described is against two simple hypotheses and considers "n" a random variable. Another difference is that there are three regions into which a test statistic, y, may fall: a zone of acceptance, a zone of rejection, and a zone of indecision (Ref 6:28-29). Consider Fig. 3.

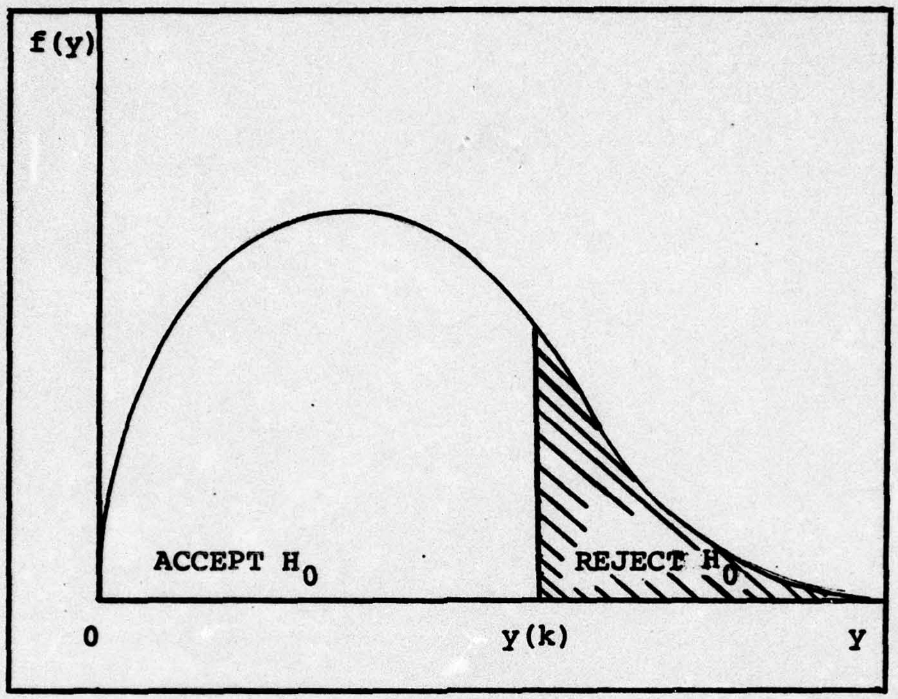

Fig. 2. Simple Fixed Sample Rejection Region

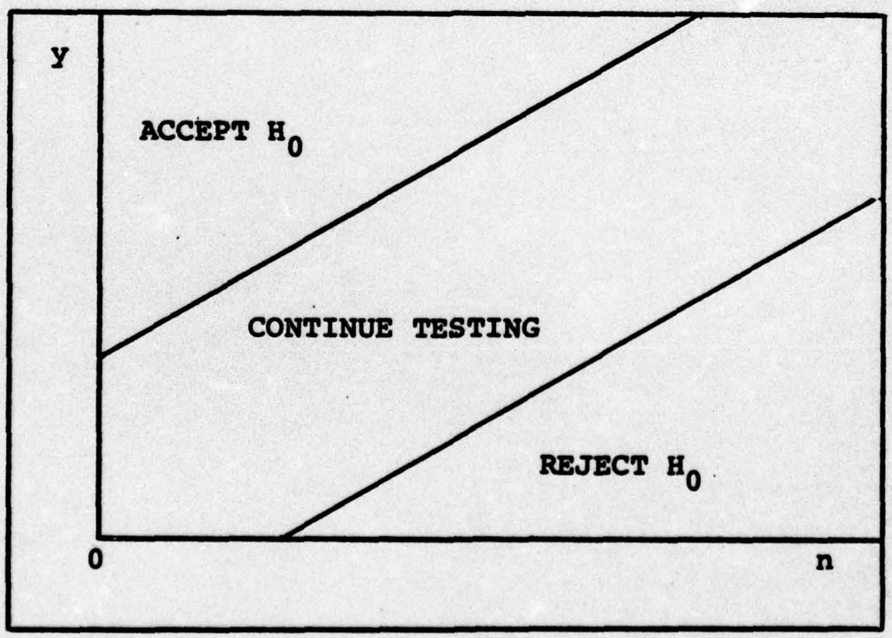

Fig. 3. A Simple Sequential Testing Region

Residence in the zones is determined by the current amount of information embodied in a test statistic (y in this case) after each successive test. The interesting quirk of a sequential test is that one leaves an "out" in testing using information as it becomes available. The "out" is the fact that when information does not merit definite acceptance of either of two alternatives, one makes a decision to obtain more information by taking another observation, adding it to the current sample, and computing a new test statistic.

Wald determined that approximate boundaries for the three zones could be constructed strictly in terms of the Type I and Type II errors desired in the test. It turned out that the same probability ratio used in constructing a critical region using Neyman Pearson technique could be used in constructing a three zone sequential test statistic (Ref 6:42). In the following section some of the necessary formulas behind sequential tests coupled with explanatory material will be presented.

Basic Sequential Formulas

Consider the probability ratio

$$\ell m = \frac{P_{1m}}{P_{0m}} = \frac{f(x_1 \theta_1) f(x_2, \theta_1) \dots f(x_m \theta_1)}{f(x_1 \theta_0) f(x_2\ \theta_0) \dots f(x_m \theta_0)} \qquad (2.2)$$

Instead of creating the inequality where the above ratio is less than or equal to some constant, k, the sequential test is constructed by bounding the ratio by two constants A and B such that

$$B \leq \ell_m \leq A \qquad (B < 1 < A) \tag{2.3}$$

To run a SPRT, a sample is taken and ℓ_m computed. If the value of ℓ_m is greater than A, reject H_0. If ℓ_m is less than B accept H_0. If ℓ_m is between B and A continue testing.

In the sequential test developed by Wald, the constants A and B are approximately formed strictly in terms of desired α and β:

$$A \leq \frac{1 - \beta}{\alpha} \tag{2.4}$$

$$B \geq \frac{\beta}{1 - \alpha} \tag{2.5}$$

Using the above bounds, Wald has shown that the probability of eventual termination of a sequential test is equal to 1 (Ref 6:43). In practice the above inequalities are considered equalities, and Wald stated that use of such boundaries, ". . . cannot result in any appreciable increase in the value of either α or β [Ref 6:46]." Suffice to say that the true values for α and β will be different from those used to construct A and B, but (without terminating a test early, "truncation") true α and β will be less than the "input" α and β used to construct boundaries (Ref 6:48).

At this point, it is of interest to present without proof formulas significant in developing SPRT's. The case described is a sequential test designed for decisions between two simple hypotheses (Ref 7:14).

The operational characteristic (O.C.) curve or probability of acceptance at a given theta is

$$L(\theta) = P(\theta/\alpha,\beta,\theta_0,\theta_1) = \frac{A^{h(\theta)} - 1}{A^{h(\theta)} - B^{h(\theta)}} \tag{2.6}$$

The term "$h(\theta)$" is a function of any given theta value and must be evaluated for the particular theta of interest at each desired point on the O.C. curve. For continuous functions, $h(\theta)$ can generally be evaluated by solving Equation (2.7) for $h(\theta)$ at θ:

$$\int_{-\infty}^{\infty} \left[\frac{f(x,\theta_1)}{f(x,\theta_0)}\right]^{h(\theta)} f(x,\theta)dx = 1 \tag{2.7}$$

Depending on the p.d.f. concerned ($f(x,\theta)$), Equations (2.7) and (2.6) may or may not be easily evaluated. For examples in the binomial and normal cases, see Wald (Ref 6:51-52).

Having determined a formula for the O.C. curve ($L(\theta)$), the expected sample size can be computed. The average sample number or ASN has one of the most appealing attributes of a sequential test. Where observations are independent, Wald has shown a relation for the expected sample number ($E(n)$) given an actual value of theta (Ref 6:53):

$$E_\theta(n) \sim \frac{L(\theta)\log B + [1-L(\theta)]}{E_\theta(z)} \log A \tag{2.8}$$

where $$z = \log \left[\frac{f(x,\theta_1)}{f(x,\theta_0)}\right] \tag{2.9}$$

Use of Sequential Tests

Sequential probability ratio tests on the average will have an ASN approximately half that of the best fixed sample tests for many distributions (Ref 6:60). Weatherill

has stressed the fact that this is really only an average quality. Since the number of samples is a random valuable, the sample size may go well beyond that of a fixed test (Ref 7:21). In 1950, A.G. Baker presented some interesting results from testing a hypothesis based on a normal population. Baker's results help focus attention on the actual range of possible values the decision number may take (Ref 11:337-338). Usually a user of a sequential test should provide protection against testing an inordinately large number of items, or testing a prolonged time since these tests do not always behave according to expected values. This protection is gained by stopping the test at some predetermined point if no decision has been made by that point. The process of stopping a test prematurely is called truncation and will have a tendency to affect the "true" values of alpha and beta. It is in the users interest to apply standardized tests where actual error values under truncation conditions are known.

The SPRT's of interest in this thesis are based on a choice between two simple hypotheses. According to Wald, "a simple hypothesis has been defined as a statement which specifies completely the values of all unknown parameters [Ref 6:70]." For example, if one were testing between means of a normal distribution, the standard deviation would be assumed known and two values for the means under two hypotheses would be completely specified. Fortunately, the SPRT can be used with composite hypotheses (Ref 6:70).

The potential user should be aware of the implications and problems involved when using simple hypotheses while expecting protection against composite ones. An excellent discussion may be found in Wald (Ref 6:70-77) and will not be further discussed here.

It should be noted that Wald and Wolfowitz have shown that by using a SPRT, the lowest possible ASN values result when the true population parameter value under test is equal to either of the specified parameters in the test (Ref 12) (Ref 7:22). Though this quality is desirable, the user should be aware that ASN may not be optimum at population parameter values between the two specified (Ref 7:22). One should note that a sequential test is usually most efficient when actual parameter values from a population are polarized below or above the parameter values specified in test construction.

In summary, the SPRT can be valuable and extremely efficient tool in discriminating between two hypotheses; however, a potential user must be aware of the possibility of certain risks inherent in its use. The next section will be used to describe a particular distribution, the Weibull, to which the theory of SPRT's can now be applied.

III. The Weibull Distribution

Walodi Weibull, a Swedish researcher for the Bofors Company, presented his "widely applicable" extreme value distribution in 1951 (Ref 13). Gumbel describes this distribution as a "Type III" distribution which is based on failure caused by "uniform stresses and isotropic brittle material" which influence the failure point on or before some point in load or time (Ref 14:32). The Weibull distribution is not restricted to reliability applications and has considerable flexibility in representing various diverse populations. However, the distribution is particularly well suited to descriptions of the time to failure of numerous different types of items when they are subjected to stress.

Before proceeding further in describing the type of populations for which the Weibull is useful, it is necessary to describe some of the details of its structure.

Probability Density Function (p.d.f.)

The Weibull represents the distribution of x. For the purpose of ease of description, this thesis will consider that x is a time until failure of some equipment or apparatus being tested. Using correct terminology, an item is described as being "placed on test" in order to observe a failure. Equation (3.1) is the p.d.f. for the Weibull distribution.

$$f(x) = \frac{k}{\theta} \left(\frac{x-c}{\theta}\right)^{k-1} \exp\left[- \left(\frac{x-c}{\theta}\right)^{k}\right] \qquad (3.1)$$

for $x>0$.

<u>Three Parameters</u>

The nature of the Weibull distribution of system lives is dependent on three parameters, k, θ, and c. The range of possible values of the three parameters provides tremendous flexibility.

The "shape" parameter, k, gives a measure of the amount of peak to the curve and is extremely important because it literally determines the shape of the curve. For example, Fig. 4 demonstrates a succession of six curves which have been extracted from a graph originally constructed by Good and Kao (Ref 15:13). One can observe the monotonically decreasing nature of each of the curves for k equal to, or less than one. For k values greater than one, the curve becomes anchored at the origin and beings to peak higher as k increases. At k equal to one, the curve represents an exponential failure distribution.

The curves in Fig. 4 have a "location parameter," c, equal to zero. The location parameter indicates the value of x at which failures begin occurring. Since, in most instances, failures can occur immediately after activation of a device (the zero point in a test), c will be assumed to be zero from this point on in this paper. Test plans developed under this assumption are readily adapted to a nonzero value of c by applying a correction to data which has a c value not equal to zero. This adaptation

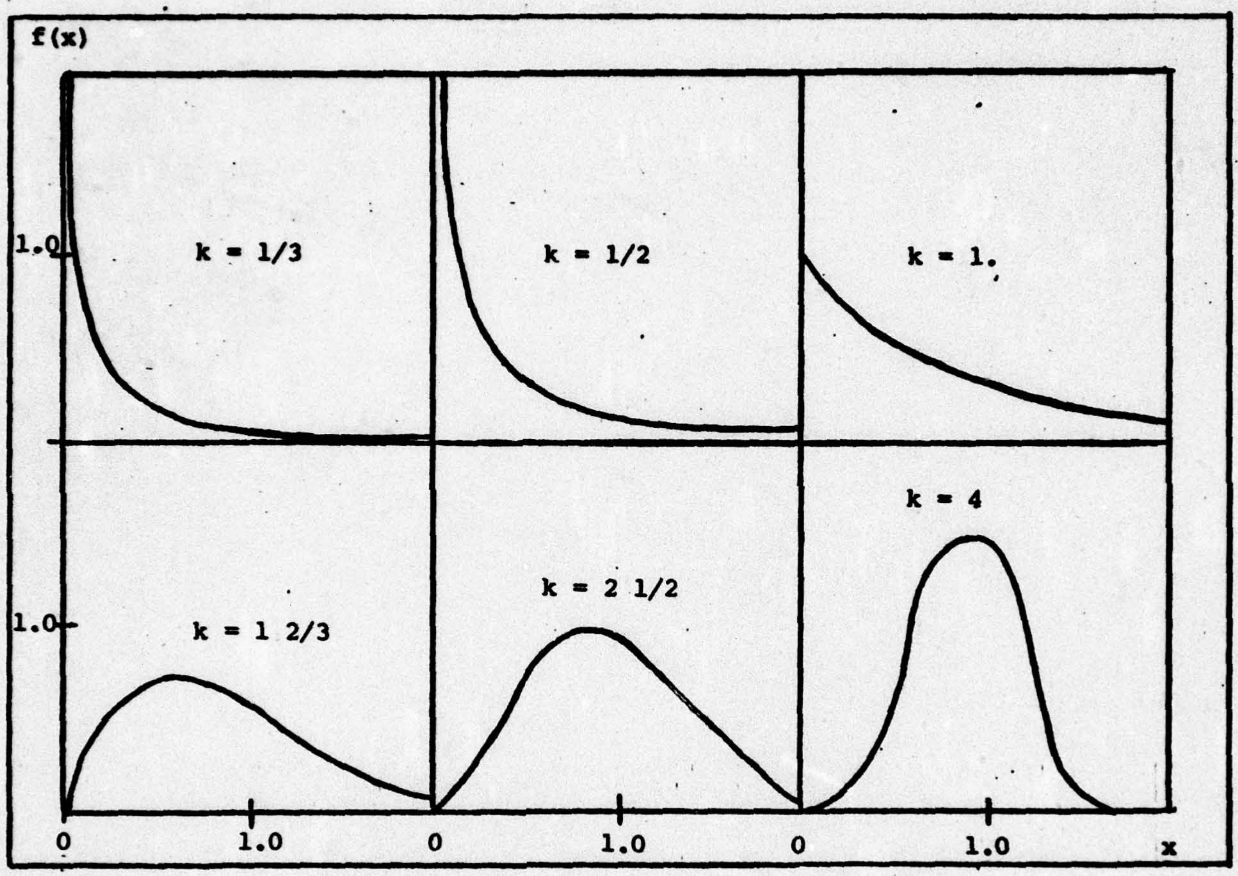

Fig. 4. A Graphical Representation of Weibull pdf's for Increasing Values of k and constant $\theta = 1.0$.

involves substracting the known value of c from all observations.

The "scale parameter," θ, is closely related to the mean of the distribution and is sometimes called the characteristic life. In life testing, the mean time between failure (MTBF) is a function of θ and k:

$$MTBF \equiv E[x] = \theta\Gamma(1 + 1/k) \qquad (3.2)$$

The effect of θ on a curve, f(x), given a constant shape parameter, is to flatten the curve as θ increases. For example, in Fig. 5, the two curves both have k equal to 2.5, but observe the significant difference between curves as θ goes from 1.0 to 1.5. As k increases, the difference

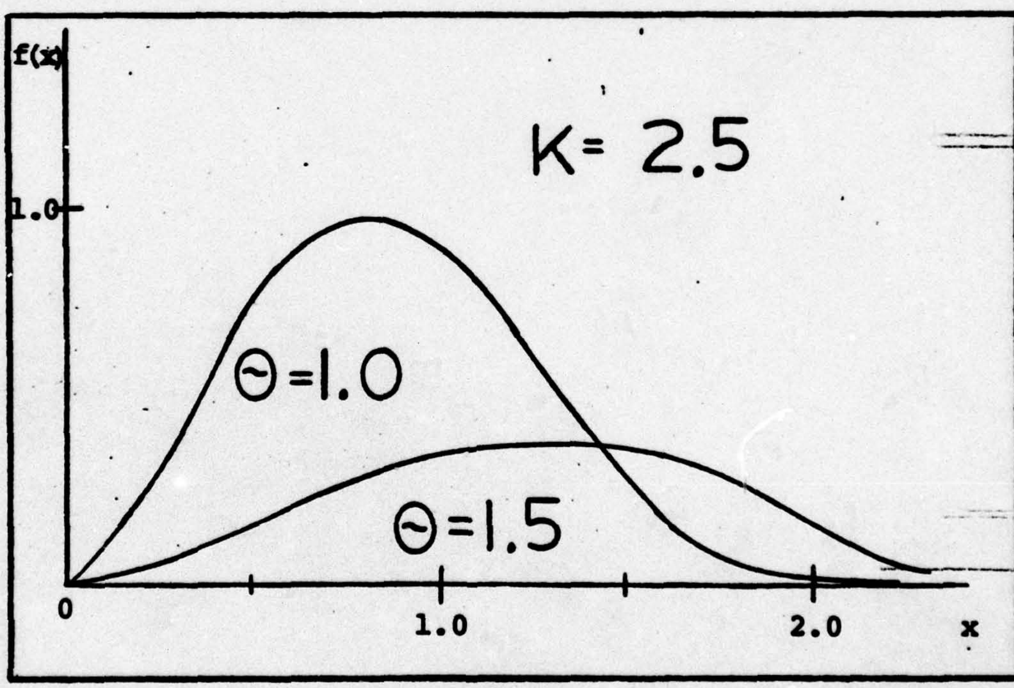

Fig. 5. A Graphical Comparison of Two Weibull Curves of Equal k = 2.5, But Different θ's. $\theta_1 = 1.0$, $\theta_2 = 1.5$.

between two given curves becomes more pronounced. This fact points up an important consideration whcn dealing with differences between two given values of θ at a specified k value. As k increases, the ability to discriminate between the two curves becomes easier.

Failure Rate

The failure rate is another important aspect of Weibull distributions:

$$k_x(x) = \frac{k}{\theta}\left(\frac{x}{\theta}\right)^{k-1} \tag{3.3}$$

The immediate impact of this function should be that the failure rate is not constant. There is one exception, the exponential distribution subcase, where k is equal to one and the failure rate is constant (1/θ). To generalize, failure rate increases for k greater than one as x increases. For k less than one, failure rate decreases as x increases. A wear-out process (fatigue for example), can be described using Weibull distributions with k greater than one. This capability indicates the potential value of this distribution. It may be critical in some cases to be able to show the effect of operation time on failure rate.

The next three equations are self-explanatory and are presented without further comment.

Three Important Equations

Cumulative Distribution Function.

$$F(x) = 1 - \exp\left[-\left(\frac{x}{\theta}\right)^{k}\right] \tag{3.4}$$

for x > 0.

jth Moment of x:

$$E[x^j] = \theta^j \, \Gamma(1 + j/k) \tag{3.5}$$

Variance of x:

$$V[x] = \theta^2 \, \Gamma(1 + 2/k) - \Gamma(1 + 1/k) \tag{3.6}$$

Order Statistics Formulas

Since some of the theory behind this thesis was developed using the relatively new field of order statistics, pertinent formulas are presented for reference. The interested reader may find a detailed development in Quayle (Ref 16).

Probability Density Function of rth Failure Out of n:

$$f(x_{r,n}) = n\binom{n-1}{r-1} \frac{k}{\theta^k} x_{r,n}^{k-1} \sum_{i=0}^{r-1} \binom{r-1}{i} (-1)^{r+i-1} \cdot$$

$$\exp\left[-\left(\frac{x_{r,n}}{\theta}\right)^{(n-1)k}\right] \tag{3.7}$$

C.D.F. for rth Failure Out of n:

$$F(x_{r,n}) = 1-n\binom{n-1}{r-1} \sum_{i=0}^{r-1} \binom{r-1}{i} \frac{(-1)^{r+i-1}}{n-i} \cdot$$

$$\exp\left[-\left(\frac{x_{r,n}}{\theta}\right)^{k} (n-i)\right] \tag{3.8}$$

jth Moment of the rth Order Statistic:

$$E[x_{r,n}^j] = \theta^j \, n\binom{n-1}{r-1} \Gamma\left(\frac{j}{k} + 1\right) \cdot$$

$$\sum_{i=0}^{r-1} \binom{r-1}{i} \frac{(-1)^{r+i-1}}{(n-i)^{(j/k+1)}} \tag{3.9}$$

Expected Value of rth Out of n Order Statistics:

$$E[x_{r,n}] = \theta n \binom{n-1}{r-1} \Gamma\left(\frac{1}{k} + 1\right) \cdot \sum_{i=0}^{r-1} \binom{r-1}{i} \frac{(-1)^{r+i-1}}{(n-i)^{(1/k+1)}} \quad (3.10)$$

Application of the Weibull Distribution

From its inception, the Weibull function has proved effective in reflecting the probabilistic nature of various extreme value type populations. The best known applications are in the reliability field, but since it is so flexible, the Weibull can prove extremely useful in describing other distributions as well. In 1951 Weibull used the distribution to describe a range of separate data types. For example, he described steel strength and fatigue life, the size of beans (vegetables), fiber strength of cotton, and even the "stature of adult males in the British Isles [Ref 13]. The applicability of the Weibull distribution in describing the time to diagnosis of carcinoma has been discussed by Peto and Lee (Ref 17) and also by Pike (Ref 18). The list can go on and on, from electronics and mechanical lives to all forms of biological adaptations. The applicability in the field of biology is not at all surprizing when one considers that a normal population can be approximated by a Weibull with shape of 3.25 (Ref 19:191).

The Assumption that Shape (k) is Known

The assumption is made that the shape parameter is known

for this thesis. The thesis is primarily oriented toward reliability testing where one desires to choose between accepting or rejecting production lots on the basis of θ. Numerous examples where a k value other than one has been used are known. Kao has shown values of k for various electron tubes (Ref 20) (Ref 21). Weibull has given k values for his examples (Ref 13). The k values for various aircraft subsystems have been found (Ref 22). Harter and Moore have presented a useful list of applications and references for many known k values (Ref 3:101). When one considers that every time a researcher uses an exponential distribution for life testing, the researcher assumes k to be unity, the idea of known shape becomes more appealing.

The literature is rich in estimation methods for Weibull parameters. The graphical method of estimating the value of the shape parameter can often be of practical value. Some good examples of graphical analysis can be found in Berretoni (Ref 23). Johnson and Katz provide a good general discussion of estimation procedures by mathematical means (Ref 24:255-262).

The fact that estimation procedures exist does not necessarily suggest that estimation of Weibull parameters is either easy or consistent. It is interesting to note that one dissenter in the use of Weibull distributions, Gorki, has emphasized the "elusive" nature of Weibull parameters (Ref 25:202-203).

This thesis rests on the premise that the parameter k can be determined given high enough previous information levels. This author believes that there are numerous examples where the assumption is warranted and inherently reasonable.

The Weibull distribution is flexible. It applies to a number of varied populations. Since it does not specify constant failure rate, its use by a potential researcher can be fundamentally realistic in reliability examinations.

IV. A Sequential Probability Ratio Test for the Weibull Distribution

Historical Development

In recent years, theory for a SPRT for the Weibull distribution has been developed. In the interest of historical perspective, this chapter will begin by considering the subcase of exponential SPRT's. There are significant parallels between exponential and Weibull SPRT's to merit this discussion. By reviewing exponential life testing and its relationships to Weibull testing, it is hoped a potential user of Weibull plans can become more comfortable with the Weibull methodology. Exponential SPRT plans have enjoyed extensive use for some time.

The interested reader is directed first to the work of Epstein, Sobel, and Tsao. A sequence of life testing papers by these authors provides an excellent framework for understanding life testing where the underlying distribution is exponential (Ref 26) (Ref 27) (Ref 28) (Ref 29) (Ref 30) (Ref 31). As previously stated, the exponential distribution assumes constant failure rate or a k value of one when represented as a Weibull distribution. Development of sequential procedures for Weibull testing can be better understood by examining the suggested exponential sequence.

One reason the exponential has been evaluated so completely might be that it represents a comparatively easy

function to work with analytically. This fact is summed up in a statement by Stevens.

> In many cases one suspects that the popularity of constant failure rate has two causes--the relative ease with which its mathematical consequences may be derived, and the difficulty of obtaining a significant departure from this hypothesis with a limited sample of data when the departure is not gross [Ref 32:38].

Whatever the reason, the exponential assumption enjoys widespread popularity and the Epstein articles provide an articulate background on which studies under the assumption may be based.

Epstein and Sobel developed a sequential test for discrimination between two values of MTBF for the exponential distribution. They established a basic inequality, Eq (4.1) (Ref 30:83).

$$B < \left(\frac{\theta_0}{\theta_1}\right) \exp\left[-(1/\theta_1 - 1/\theta_0)\ V(t)\right] < A \qquad (4.1)$$

$$\text{for } B < 1 < A$$

A and B in (4.1) are the classic bounds for Wald type regions expressed in terms of desired α and β. The values θ_0 and θ_1 represent the desired and minimum acceptable MTBF and are specified under the hypotheses:

$$H_0 : \theta \geq \theta_0$$

$$H_A : \theta \leq \theta_1 \qquad (\theta_0 > \theta_1$$

Under a sequential test procedure one accepts H_0 on violation of the left inequality in (4.1) and accepts H_A (reject H_0) on violation of the right inequality. The test statistic V(t) can be interpreted as "the total life

observed up to time t [Ref 30:83]."

There are three different ways one might conduct the sequential test just described. These ways will be represented as three separate cases to facilitate future description. Under Case I, one test item is placed on test at a time until failure or a decision. If the decision is made to continue the test after a failure, the failed test item is replaced by another and the test continued. Case II specifies that n units are placed on test and are not replaced after failures. The test is terminated after a decision is reached or after the nth failure. Under Case II the failure distribution must be represented by order statistics for a dependent sample. Epstein and Sobel comment,

> Indeed it seems fairly clear that observations will occur in an ordered manner in life test situations whether we talk about the life of electric bulbs, life of radio tubes, life of ball bearings, life of various kinds of physical equipment or length of life after some treatment performed on animals or human beings [Ref 27:486].

Case III specifies that n' units may be tested simultaneously and replaced after failure. This case is really the generalized case for replacement. The formulas for each case have been derived [Ref 30:83):

$$\text{Case I:} \quad V(t) = t \tag{4.2a}$$

$$\text{Case II:} \quad V(t) = \sum_{i=1}^{r} x_i + (n-r)t \tag{4.2b}$$

$$\text{Case III:} \quad V(t) = n't \tag{4.2c}$$

The reader will notice that in each case, the test statistic V(t) is merely the total time on all items which

have been tested at time t. It is not considered important to further belabor theory of exponential SPRT's. These tests are fully described and are a basis for a current military standard, MIL-STD-781B (Ref 33). The meaning of the statistic V(t) is important because it can be generalized for tests of Weibull populations with known k.

The Weibull SPRT Between Two Scale Parameters

If a random variable X is defined as a Weibull distributed time to failure of a test unit, it has been indicated that a random variable Y, defined by the relation $Y=X^k$, is exponentially distributed when k is the shape parameter for the Weibull distribution. The mean of the exponential distribution thus formed is θ^k where θ is now the scale parameter of the Weibull distribution (Ref 34:406). The reason for emphasizing exponential development is clearer. Given the preceding relationships, it is possible to set up a SPRT between specified scale parameters for Weibull distributions when k is assumed known. These SPRT's have been developed for both Case I and Case II life tests. The next section will describe these developments to date.

Case I. The reader will recall that Case I implies testing one unit at a time with replacement. Nicholae and Obreja developed necessary formulas for Case I testing between specified scale parameters of Weibull distributions in 1971 (Ref 1). Working independently, Callahan presented an in depth examination of both Case I and Case II testing

in 1974. Callahan's thesis included extensive Monte Carlo examinations of Weibull SPRT behavior (Ref 2). Williams presented some standardized test plans for Case I in 1975 (Ref 4). Williams included large scale Monte Carlo evaluations of his test plans. All these works described SPRT's between scale parameters under the assumption of known shape. A recent paper by Harter and Moore indicates that an equivalent SPRT between specified MTBF's can be constructed (Ref 3:101-102). When the shape is known, the MTBF is completely specified when the scale parameter is specified; hence, the equivalence of the tests.

Since this paper recognizes the equivalence of the two tests, and considers a test between scale parameters less complicated computationally in practice, only formulas for testing between scale parameters will be presented. The reader interested in a complete development is referred to (Ref 1) and (Ref 2).

In Case I and following cases, the Weibull SPRT is defined as a test between a desired scale parameter, θ_0, and a minimum acceptable scale parameter, θ_1, where $\theta_0 > \theta_1$. In practice, it is more realistic to represent the hypotheses as composite:

$$H_0: \theta \geq \theta_0$$
$$H_A: \theta \leq \theta_1 \qquad \theta_0 > \theta_1.$$

Since a formula such as (4.1) is difficult to work with, boundary inequalities can be simplified to a more workable

form. The basic inequality for Case I testing is:

$$rs - h_2 \leq V(t) \leq rs + h_1 \tag{4.3}$$

where

$$h_1 = \frac{-\ln(B)}{(1/\theta_1^k - 1/\theta_0^k)} \tag{4.4}$$

$$h_2 = \frac{\ln(A)}{(1/\theta_1^k - 1/\theta_0^k)} \tag{4.5}$$

$$s = \frac{\ln(\theta_0^k/\theta_1^k)}{(1/\theta_1^k - 1/\theta_0^k)} \tag{4.6}$$

Under Case I, the test statistic becomes

$$V(t) = \sum_{i=1}^{r} x_i^k \tag{4.7}$$

Inequality (4.3) is the defining inequality for the three regions specified in a Wald type SPRT. The constants, A and B have been given previously in Equations (2.4) and (2.5). The test statistic, $V(t)$, is simply the sum of all Weibull lives observed, each raised to the k power. There are three possible decisions the researcher may make while conducting the SPRT. These decisions are:

I. Accept H_0 if $V(t) \geq rs + h_1$

II. Reject H_0 (Accept H_A) if $V(t) \leq rs + h_2$

III. Continue testing if neither boundary is violated.

The three decision regions are indicated graphically in Fig. 6.

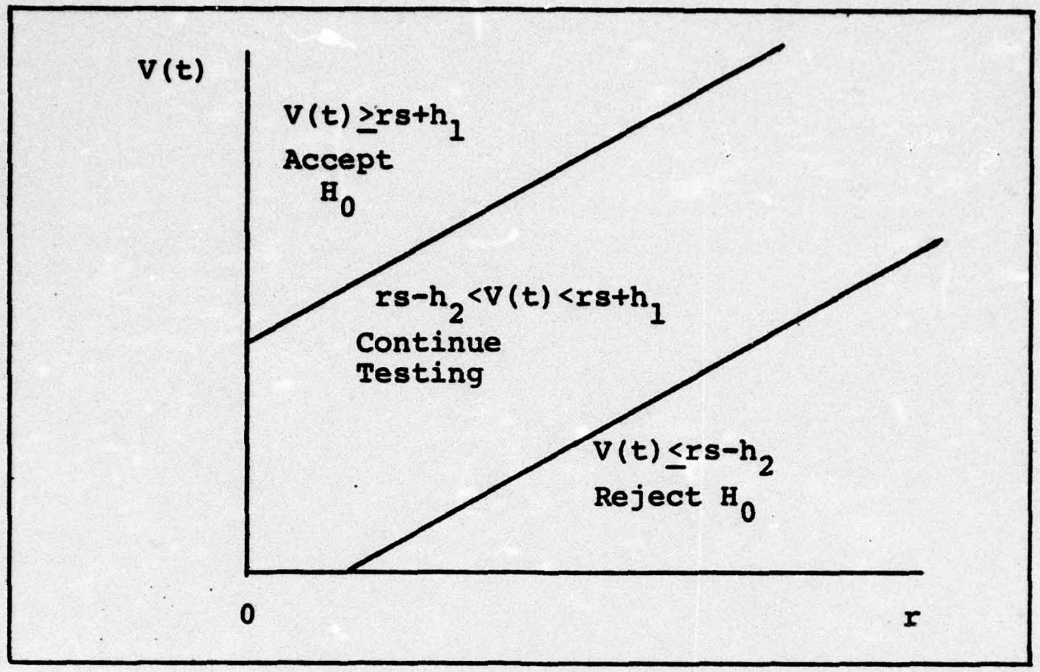

Fig. 6. Regions for a Wald SPRT for the Weibull Distribution.

The expected number of failures E[r] given a true value for θ can be determined and is dependent on $L[\theta]$, the probability of acceptance of H_0 given that value.

$$E_\theta[r] = \frac{h_2 - L[\theta](h_1 + h_2)}{s - \theta^k} \qquad \text{for } \theta^k \neq s \tag{4.8}$$

Formulas have been developed for $E_\theta[r]$ for θ equal to 0, θ_1, $s^{1/k}$, θ_0, ∞ (Ref 2:32). Points of most interest are usually at θ_0, θ_1 and $s^{1/k}$.

$$E_{\theta_0}[r] = \frac{h_2 - (1 - \alpha)(h_1 + h_2)}{s - \theta_0^k} \tag{4.9a}$$

$$E_{\theta_1}[r] = \frac{h_2 - \beta(h_1 + h_2)}{s - \theta_1^k} \tag{4.9b}$$

$$E_{s^{1/k}}[r] = \frac{h_1 h_2}{s} \qquad (4.9c)$$

Under Case I the expected time $E_\theta[t]$, required to make a decision given a true value of θ is dependent on $E_\theta[r]$.

$$E_\theta[t] = E_\theta[r]\theta\Gamma(1 + 1/k) \qquad (4.10)$$

It should be noted that Equations (4.9a) through (4.10) are evaluated exactly at the test boundaries. The assumption here is that one can observe test items at all times and make decisions continuously. In many cases it may be practical to accept an overshoot of the boundaries by restricting decisions to failure points. One can expect the expected value formulas to be lower than the true expected values for this sort of "discrete" test (Ref 2:33).

Test construction and expected performance under Case I have been described. The reader can imagine that such a test could last a long time. Tests under Case I have the longest duration of the three cases. They do guarantee a minimum expected waste of test items however. The next section describes a method for decreasing the time required to make a decision.

<u>Case II</u>. Case II can be called an "accelerated test" because, by putting n items on test at once without replacement, the user can decrease the actual time required for the test to run. The user creates a dependent sample of size n. The items fail in order of weakest to strongest. The distribution of the rth out of n order statistics has been

shown for the Weibull. Using that distribution, a new probability ratio to be used in a SPRT can be evaluated.

$$\ell_{r,n} = \frac{f(x_1,n,x_2,n, \ldots, xr,n,t;\theta_0)}{f(x_1,n,x_2,n, \ldots, x_r,n,t;\theta_1)} =$$

$$\left(\frac{\theta_0}{\theta_1}\right)^{rk} \exp\left[-(1/\theta_1^k - 1/\theta_0^k)\ V(t)\right] \qquad (4.11)$$

An examination shows that a test using Equation (4.11) can use the same test bounds previously described under Case I. The only difference between the two ratios is a value for V(t). Under Case II:

$$V(t) = \sum_{i=1}^{r} x_{i,n}^k + (n-r)x_{r,n}^k \qquad (4.12)$$

Callahan has shown an "essential equivalence" between Case I and Case II Weibull testing. As long as $n>r$, the expected number of failures required to make a decision is independent of n, the number placed on test (Ref 2:25-26). Equation (4.8) can be used for Case II as well as Case I.

Fortunately the expected time to make a decision is not equal to that for Case I. The expected time to make a decision is compressed to the expected life of the $E_\theta[r]$th order statistic, or

$$E_\theta[t] = E_\theta[x_{r,n}]$$

This value has already been given in Equation (3.10).

Substantial decreases in the required time to make a decision are possible under Case II. This time saving feature underscores one of the major reasons for the thesis. A thorough evaluation of time saving alternatives based on

standard test plans is an asset in any reliability program. In many cases it may be in the users interest to cut down the duration of testing. These cases will be examined more fully in a later chapter.

At this writing, only Case I and Case II Weibull SPRT's had been developed in the literature. The next section gives a statistic for Case III which helps to provide flexibility similar to that enjoyed in the use of exponential SPRT's.

Case III. It is possible to present the test statistic which will operate under Case III conditions by merely extending concepts of exponential testing to Weibull testing. The statistic derived has been checked empirically by Monte Carlo computer studies. The author will outline the ideas behind its development in this section. The evaluation of the statistic will be presented later.

As previously mentioned, Epstein and Sobel developed a SPRT for the exponential under Case III conditions (Ref 30:83). Under Case III, n' items are placed on test simultaneously with replacement after failures. Like Case II testing, Case III decreases the time factor in making a decision. The degree of time collapse is directly related to the number of test stands in operation, thus allowing a user to decide how long a test should run by determining the number of items he is willing to test simultaneously.

Unfortunately, Equation (4.2c) is not as easily transformed for use with the Weibull distribution as were Equations (4.2a) and (4.2b). However, a basic parallel between exponential and Weibull distributions is still operative. To formulate a V(t) statistic, one should transform Weibull time to exponential time and find a value for the new total exponential "time." This is essentially what was done in Case I and Case II.

The test statistic for Case III Weibull tests is developed as the sum of Weibull time transformed to exponential time as in Case I and II. However, a simple exercise illustrates why Equation (4.2c) cannot be simply modified to Eq (4.13) in the same way Eqs (4.2a) and (4.2b) were modified.

$$V(t) = n't^k \qquad \text{(IMPROPER)} \qquad (4.13)$$

Consider Figure 7. The double vertical line indicates a cutoff point for the test. There are three test stands, I, II, and III. The test is examined at time t immediately after the item on stand III has failed. Items have failed previously on stands I and II. Currently, two items are still operating on these stands. Assume that k for the distribution is 2. Therefore using Equation (4.13):

$$n't^k = (3)\cdot(3)^2 = 27$$

It is easy to see that this is not a very good approximation of total exponential test time:

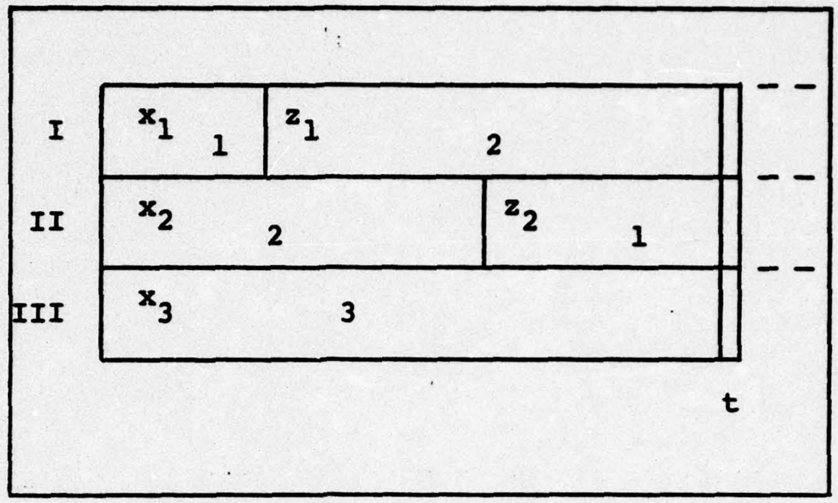

Fig. 7. Simple Test Stand Operation

For failed items:

$$x_1^k + x_2^k + x_3^k = 1^2 + 2^2 + 3^2 = 14$$

For unfailed items

$$z_1^k + z_2^k = 2^2 + 1^2 = 5$$

Total Exponential (Transformed Weibull) Time = 19

The way in which test items fail greatly affects any summation of transformed values. The alternative is to actually sum the transformed lives of all items at any time of interest, t. To construct an algorithm, consider the Weibull time to failure of items already failed as x_i where the subscript indicates the order of failure. One expects there are r failures until any decision is made. At any given moment, there should be n' items which have not failed yet. Indicate these items by z_j, where the subscript indicates a particular test stand. In the case in Fig. 7 z_3 is equal to zero since the observation moment was exactly

at the failure of the item on test stand III. The way is now clear to present a mathematical representation for a new V(t):

$$V(t) = \sum_{i=1}^{r} x_i^k + \sum_{j=1}^{n'} z_j^k \tag{4.14}$$

This new V(t) has the attribute of decreasing test time when used in a SPRT using the original bounds for Case I and II. The expected number of failures, $E_\theta[r]$ is approximately given by Equation (4.8).

The expected time to reach a decision where n' items are placed on test with replacement can be approximated using a variation of a formula given by Epstein and Sobel (Ref 31:442):

$$E_\theta[t] = E_\theta[r][\theta\Gamma(1 + 1/k)]/n'. \tag{4.15}$$

Equation (4.15) is simply the number of failures expected multiplied by the MTBF divided by the number of test stands in operation.

It is also of interest to note that a Case III SPRT thus constructed achieves equal power with both Case I and Case II. The Case III test appears to allow a flexibility for Weibull SPRT's (between specified scale parameters for k known) that compares favorably with exponential SPRT's.

This section has introduced the three different types of Weibull SPRT's. The next chapter will examine the nature of standard test plans, and present methods used for this thesis. It will prove helpful for the reader to refer to

Fig. 8 when necessary. Fig. 8 outlines Weibull and exponential SPRT's between scale parameters.

$H_0: \theta \geq \theta_0$ $H_1: \theta \leq \theta_1 \qquad \theta_0 > \theta_1$	
$rs - h_2 \leq V(t) \leq rs + h_1$	
Exponential V(t)	Weibull V(t)
Case I: $\sum_{i=1}^{r} x_i = t$	$\sum_{i=1}^{r} x_i^k$
Case II: $\sum_{i=1}^{r} x_i + (n-r)t$	$\sum_{i=1}^{r} x_i^k + (n-r)x_{r,n}^k$
Case III: $n't$	$\sum_{i=1}^{r} x_i^k + \sum_{j=1}^{n'} z_j^k$

Fig. 8. SPRT Statistics for Exponential and Weibull Tests.

V. Constructing a Useful Set of Weibull Plans

Developing a standard set of SPRT plans is a two step project. The first step is to limit the number of test plans desired to a reasonable size. When dealing with a two parameter continuous distribution, this involves numerous considerations which should be evaluated. These considerations include scope, cost, desired performance, and format. The costs of construction are measured in both available development time and resources. The major resource expense in this thesis was computer time due to the use of Monte Carlo methods.

The second step in standard test plan construction is to provide a full evaluation of the performance of the final test plans presented. Without this evaluation, it is difficult for a potential user to budget the test program or have faith in the use of the plans.

Chapter Five deals with the first step, limiting the scope, size, and content of the test plans which will be presented. Later chapters will describe computer techniques and evaluations.

Generality versus Performance

The first decision which had to be made in limiting the scope of these Weibull SPRT plans was the question of generality. That question was whether to include a

broad range of tests applicable to a majority of Weibull populations, or to select a few specific populations and try to optimize tests for each one. The generality question centers on the number of k values to include in the study.

The number of k values which could be included was limited, but since the k parameter is so important in determining a distribution, it is believed that as many k values as feasible should be included in this study. The author admits to a bias toward generality.

Previous work has shown that a set of forty shape parameter values will provide a degree of protection against sensitivity to shape in Weibull SPRT's. This set was used by Williams for a set of standard Case I tests (Ref 4:50-60). It is assumed that a standard SPRT for any case testing based on one of Williams' forty k values will be sufficiently robust to minor deviations from that k in the population being tested. The use of these forty values provides the additional bonus of compatibility with Williams' plans.

The shape parameters considered range from .5 to 5.7. Plans based on these values should apply to the majority of known Weibull populations. It was felt that the generality of test plans based on forty values for k would be extremely valuable to a potential user desiring a test plan to fit a specific population.

By specifying a wide range of k values, problems develop in the performance determination stage of test plan

development. The computer methods used to evaluate the test plans are extremely effective, but can become expensive in terms of computer time. This is particularly true for evaluations of tests using k values less than one. The price of the generality of a wide range of k values is the inability to spend resources on obtaining nice round error figures close to designated values.

In many statistical tables, it is customary to provide standard error values for α and sometimes β. These values are convenient because they are conceptually appealing to a potential decision maker. For example it is easiest to present an argument if one can establish a nice round error figure like .001, .05, or .10. In fact, some researchers have grown to expect tests with such "optimal" error figures.

It is possible to change performance of a truncated SPRT through manipulation of the test boundaries. These methods have been discussed by Williams (Ref 4:38-49). An optimum combination of input errors (to construct test boundaries), coupled with an optimum truncation point can provide desired exact performance for a SPRT. Williams has shown that manipulation of truncation point can be an effective means of controlling true error for a truncated SPRT. The author would like to point out that any attempt to optimize true error is both subjective and expensive when Monte Carlo analysis is used for evaluation.

MIL-STD-781-B provides for a set of "designated" errors

for truncated exponential SPRT plans. The standard also provides matching actual errors to be expected for tests run for designated error levels. These errors are summarized in Table I. The values are taken directly from the standard (Ref 33:60).

Table I

MIL-STD-781-B Test Plans and Risks

MIL-STD-781-B		Designated		Actual	
Test	Discr. Ratio	α	β	α	β
I	1.5	.10	.10	.115	.125
II	1.5	.20	.20	.227	.232
VII	1.5	.30	.30	.319	.328
IX	1.25	.35	.30	.363	.397

The reader will note immediately that the actual errors for the standard are far from optimal (equal to designated errors), and in every case but one, overshoot the designated error. It appears that designated performance is not essential even in accepted standard plans. The standard does state, however, "Shifts in the accept/reject lines and truncation points were made to bring the true risks closer to the desired (designated) risks and to make the two risks more nearly equal for each plan [Ref 33:60]." The intent of this section is not to decry the worth of MIL-STD-781-B, but to point out the subjective nature of a search for optimal performance in a "standard."

For the purpose of this thesis, the search for an

optimum (creating tests with performance close to desired or designated performance) was considered unnecessary. The performance exhibited by Wald type SPRT's for the Weibull distribution appears excellent when designated error values are used as "input" values to construct the test bounds. Such plans can be presented at face value. It is believed that sets of plans applicable to a wide range of Weibull distributions, though somewhat less than "optimal," would be more valuable than plans for a few selected shape values. When coupled with computer evaluations and comparative test performance analysis under various case testing conditions, a general set of tests becomes more valuable. It is hoped that a researcher desiring to test almost any Weibull population will find an efficient tool in the sets of test plans presented.

Given the preceding arguments for generality, the decision was made to select four sets of risk levels (α, β) to be used in test construction. These "input" values for α and β cover a spectrum of risk levels desirable to a potential user. Forty test plans are constructed for each pair of risks. These plans are identified by Roman numerals I through IV and are identified in Table II. It is believed that these risk levels provide protection similar to that given in MIL-STD-781-B.

Table II

Weibull Test Plans and Designated Risks

Test	Input Risks	
	α	β
I	.05	.05
II	.10	.10
III	.20	.20
IV	.30	.30

Discrimination Ratio

Very little mention has been made of the discrimination ratio up to this point. This ratio is simply the ratio of desired scale parameter to the minimum acceptable scale parameter.

$$\text{Discrimination Ratio} \equiv \theta_0/\theta_1 \qquad (5.1)$$

Williams has described an interesting aspect of Weibull SPRT behavior which helps to limit the number of test plans which need to be presented for various discrimination ratios of interest (Ref 4:32-36). Since this aspect is so important to this thesis, the arguments stated by Williams will be repeated here. The reader should refer back to Eqs. (4.3) to (4.6) in considering the following development. The basis of the argument is that it is possible to normalize values of scale parameters in terms of time units equal to θ_1 instead of standard units such as days, hours, or minutes.

If one interprets all times in terms of θ_1, a "normal time unit," a new relation for the denominator in equations for h_1, h_2, and s would result:

$$d = 1 - \frac{1}{(\frac{\theta_0}{\theta_1})^k} \tag{5.2}$$

The numerator in Equation (4.6) is already expressed in such a manner.

$$n = \ln\,(\frac{\theta_0}{\theta_1})^k \tag{5.3}$$

By substituting a new value for the discrimination ratio in Equations (5.2) and (5.3), it is possible to express terms used to construct the test boundaries in terms of that value:

$$\frac{\theta_0}{\theta_1} \equiv \theta \tag{5.4a}$$

$$h_1 = \frac{-\ln\,(B)}{1 - 1/\theta^k} \tag{5.4b}$$

$$h_2 = \frac{\ln\,(A)}{1 - 1/\theta^k} \tag{5.4c}$$

$$s = \frac{\ln\,\theta^k}{1 - 1/\theta^k} \tag{5.4d}$$

It may be confusing to the reader to now consider the discrimination ratio represented by a symbol previously reserved for scale parameters. In reality, θ is simply a normalized value for the desirable scale parameter since θ_1 is now unity.

Everywhere that θ appears in Equations (5.4b) to (5.4d) it appears as θ^k. This fact allows an interesting property for test boundaries constructed with any standard discrimination ratio. Consider that test plans are available for one standard value of θ, θ_{STD}. Consider also that it is desirable to have a test plan for another discrimination ratio θ_x. Test plans developed for the standard can be used for other ratios as long as the equality in Equation (5.5) holds:

$$\theta_{STD}^{k_{STD}} = \theta_x^{k_x} \tag{5.5}$$

An example will illustrate this property. Suppose an engineer wishes to test a production lot of bearings. The engineer feels confident in using a discrimination ratio of 2.0 but standard test plans are only available for a discrimination ratio (θ_{STD}) of 1.5. It is known that the particular bearings fail consistently in a manner which can be described by a Weibull distribution k of 1.46. In this case, the engineer can easily use test boundaries from the standard which apply almost exactly to his specific test.

$$\theta_{STD} = 1.5 \qquad\qquad \theta_x = 2.0$$

$$(1.5)^{k_{STD}} = (2.0)^{1.46}$$

$$k_{STD} \equiv 2.5$$

The boundaries can be used from a standard test constructed with θ equal 1.5 and k value of 2.5. In running

the test, the test statistic will be computed in a normal way using the shape parameter of the actual distribution (1.46).

Williams has shown that equivalent test plans have the same expected α and β errors and the same expected number to reach a decision (Ref 4:62-65). That author has used a standard θ of 1.5 to construct his Case I plans. This thesis also uses that value both in the interest of compatibility and generality.

Truncation

Whenever the decision is made to use a sequential procedure, the user must be able to limit the risk of a prolonged test. As previously stated the expected values of t and r are purely average properties. Variability in testing results is expensive and should be curtailed. The method used to terminate a sequential test prior to incurring excessive cost is called truncation. There are numerous truncation schemes available. Variations of these methods are fully discussed in (Ref 4).

The truncation procedure used for this thesis is based on work by Aroian (Ref 35). It is called a "right angle" truncation because it truncates the test for either excessive time or excessive failures in testing. A diagram of such a test is shown in Figure 9.

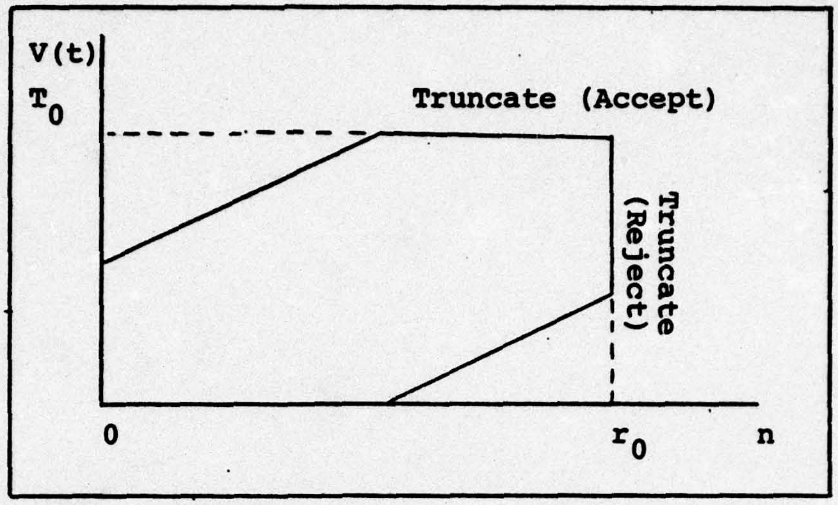

Fig. 9. Diagram of "Right Angle" Truncation

The truncation boundary formulas were developed for Weibull SPRT's by Callahan (Ref 2:36-41). A description of Weibull truncation bounds will now be presented.

If one can select some specified number of failures, r_0, beyond which a SPRT should not be continued, it is possible to express a value for the test statistic based on time where a truncation acceptance should occur:

$$V(t) = T_0 \tag{5.6a}$$

$$T_0 = r_0 s \tag{5.6b}$$

The s in Eq. (5.6b) is given by Eq. (4.6).

There are various opinions on where to truncate a SPRT with respect to number of failures observed. Epstein and Sobel contend that a value for r_0 large enough to provide approximate expected test behavior should be (Ref 30:86):

$$r_0 > 3 \max_\theta E_\theta [r] \tag{5.7}$$

Callahan has stated that Equation (5.7) may be conservative

(Ref 2:42). Williams used a smaller value for r_0 (Ref 4: 31):

$$r_0 = 2\, E_{\theta_0}\, [r] \qquad (5.8)$$

Harter and Moore have recommended a multiplication factor of two times the expected number of failures. This factor is also appealing because it facilitates realistic comparison with fixed length plans (Ref 34:31).

For this thesis a value for r_0 slightly different from Equation (5.8) was chosen:

$$r_0 = 2\, E_{\theta_1}\, [r] \qquad (5.9)$$

This value for r_0 is based on the expected failures given that θ_1 is the true parameter since in all cases values given by Equation (5.9) will be larger than those given by Equation (5.8). This value for r_0 allows for slightly larger, more flexible tables and slightly improved performance over r_0 given by Equation (5.8).

A multiplication factor of 2.0 for truncation number was used for all the test plans which were constructed. Given a value of r_0, an "accept" truncation boundary is determined by Equation (5.6b). Fig. 10 summarizes graphically the boundaries of SPRT plans presented in this thesis.

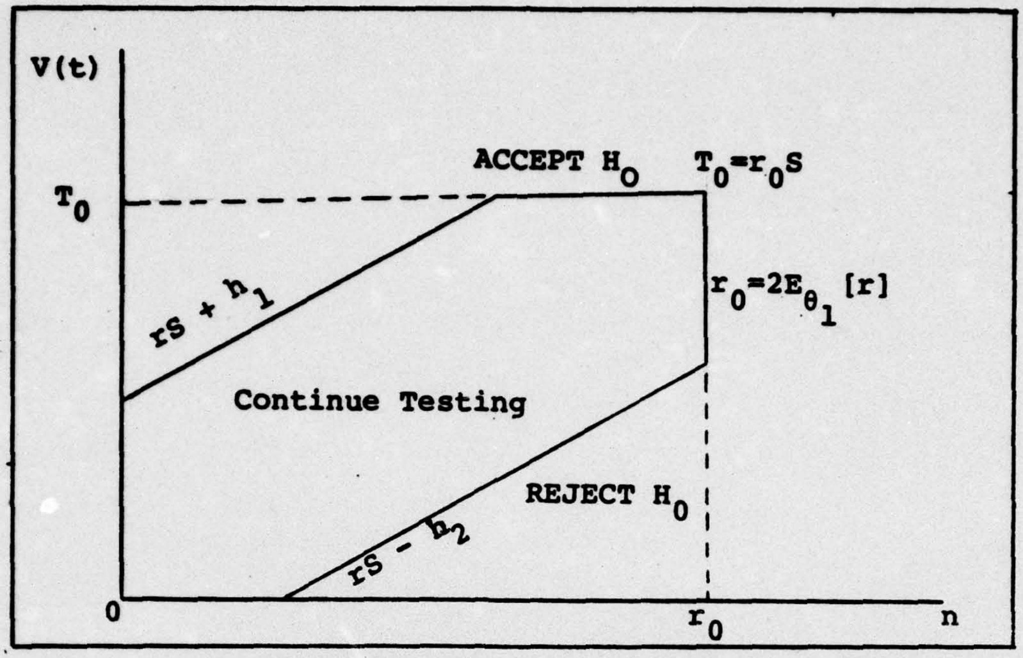

Fig. 10. Test Boundaries for Standard Weibull Test Plans.

VI. Computer Methods and Output

Computer methods were vital to the development of this thesis. This chapter is devoted to a description of the methods used and the output of those methods. Three of the basic computer programs are displayed in Appendix I. The output of these programs can be either standard plans or evaluation tables. Appendices A through H catalog the computer output. This output is organized so that a prospective user can examine alternative evaluations of test plans and then extract the desired one from the immediately following appendix. Therefore, the appendices alternate by risk levels designated, first evaluations then standard plans.

By reading this chapter, it is hoped that a potential user will have a better understanding of the output presented. The chapter is not a lesson in programming. Rather, the discussion centers on a general description of the operations which provide a basis for data production.

The machine used for this thesis was the CDC 6600 Cyber 74 Computer. The maximum storage required ranged from approximately 36,000 to 40,000 words. Execution time for the various programs ranged up to 4300 decimal seconds and was highly influenced by the input risks, size of shape parameter, and sample size for the simulations.

This chapter is divided into four major sections. The first section describes the topic of Monte Carlo generation of samples. The second section is devoted to the standard plans including their construction and a description of the printed output in the appendices. Section three briefly describes the operation of the three basic simulations. The final section describes the evaluation tables.

<u>Monte Carlo Simulation</u>

Monte Carlo simulation is simply a means of simulating the operation of a test using artificially produced random samples from a specified distribution. If the cumulative distribution function F(x) for some pdf, f(x), is known and invertable, one can produce random variables from that distribution using artificially generated uniform random variables. The internal function RANF(n) on the Cyber system can be used to generate those variables between 0 and 1. Given a random variable "u" produced by the machine, one can generate a variate "x" from a specified Weibull distribution:

$$u = F(x) \tag{6.1}$$

$$x = F^{-1}(u) \tag{6.2}$$

$$x = \theta[-\ln(1-u)]^{1/k} \tag{6.3a}$$

$$x = \theta[-\ln(u)]^{1/k} \tag{6.3b}$$

Using either Eq. (6.3a) or (6.3b), one can generate any number of Weibull variates which can be used in a

simulation of a certain type of test. The generators used in the programs in Appendix I are subroutines called "VALUS(INP) and VALU(INP)." These subroutines provide either sorted sets or single values of Weibull variates which are used to simulate SPRT's in other parts of the programs.

This short section on Monte Carlo was presented first so that the reader will understand the meaning of the terms "Monte Carlo simulation." Before going into explanations of specific simulations, the next section describes the standard plans used in all the simulations.

Standard Test Plans

Each of the three programs in Appendix I contains a subroutine called "TABLE." When called, this subroutine calculates and stores in memory the boundary values at all possible failure numbers for a particular SPRT. One might say that this subroutine creates and stores a numerical image similar to the visual image shown in Fig. 10.

Once the boundary values for a specific test have been constructed, they can be used in a simulation in a "TESTER" subroutine and/or they can be printed out by a "PRINT" subroutine.

The second program presented has the capability to do both, and conducts Case II testing. It is interesting to note here that all programs in this thesis can be

considered mutations of this second program, "NONREP." The program "NONREP" has the capability to print out desired tables, and an evaluation of the tables can be included in the heading information. The plans in the Appendices B, D, F, and H were generated from NONREP but include only descriptive information in their headings.

An example of a "standard" plan is presented in Fig. 11. Each test is labeled according to risk designated by Roman numerals as previously discussed. Following the numerals is a number between one and forty which represents a code for the assumed shape parameter. Other information included in the heading further categorizes the test plan by listing pertinent details of construction

```
                                          TEST III-25

K,SHAPE =1.8000             DISCRIMINATION RATIO=  1.500
INPUT ALPHA=   .200         INPUT BETA=   .200
E(N)     =    3.92672       E(N) MULTIPLIER =  2.00
```

TEST	ACCEPT	REJECT
1	4.085	0.000
2	5.484	.142
3	6.903	1.551
4	8.312	2.959
5	9.721	4.358
6	11.130	5.777
7	11.271	7.186
8	11.271	8.595

Fig. 11. Example of a Standard Weibull SPRT Plan

such as shape parameter, discrimination ratio, designated input risks, expected number of failures given θ_1, and the multiplication factor used to obtain r_0. The items in the table itself include specific failure numbers under "TEST" and the boundary values at those points.

It is important to note the significance of these boundary values as given. Recalling that tests were constructed using a normalization technique in terms of θ_1, one must be able to interpret the accept/reject values relative to θ_1. In MIL-STD-781-B, the SPRT boundaries are presented in terms of the specified or desired MTBF (Ref 33:19). This is not at all the case with these Weibull SPRT's. The accept/reject bounds in these plans are in terms of θ_1^k. When interpreted in this way, the user can use actual population values to construct the sequential statistic V(t) without normalizing each one in terms of θ_1. A user can adapt any of the standard plans to his particular testing specifications using most simple hand calculators by multiplying the listed boundary values by his specific θ_1^k.

The standard plans are presented in Appendices B, D, F, and H. Preceding each set (in Appendices A, C, E, and G), are evaluations of the plans. This ordering scheme is for the user who selects a risk level, requires a quick check of performance capability and options, and then extracts the desired standard plan. The next section will discuss how the evaluation simulations

operate which are used to prepare evaluation tables.

Operation of Simulations

The programs of Appendix I are designed to simulate different types of Weibull testing. Three simulations represent the three cases of sequential life tests. Although Case I is really a subset of Case III testing, there are significant differences in developing simulations for the two cases. That is one of the main reasons for presenting a three case classification. The three simulations increase in complexity from Case I to Case III.

In general, each simulation operates the same way. A control program provides a set of tests which will be evaluated. In sequence, for each standard test, it creates and stores boundary values, simulates a particular test a specified number of times, tabulates the results, and prints out desired output. The "results" implied are simply averages related to performance.

The simulations used are very much a continuation of previous work by Williams and Callahan. The Case I simulation is very similar to one used by Williams to construct his standard tables, particularly in format and use of subroutines (Ref 4:139-143).

Prior to discussing the simulations it is necessary to further clarify the distinction between discrete and continuous testing. In discrete testing decisions are made only after a failure occurs. In the continuous case, a decision is made at the instant the value of V(t)

crosses a test boundary. Continuous testing assumes that the researcher has the resources available to continuously monitor/evaluate the current value of V(t). The values for expected time to a decision and expected number of failures to a decision are greater for discrete testing than they are for continuous testing.

Except where noted, the simulations for this thesis were based on discrete testing. It is the author's opinion that the complications of Weibull SPRT operations are significant enough as to bias testing toward discrete operations. Discrete simulations are also easier to construct.

Case I. The program "ONETIME" is based on simulation of Case I testing where units are tested one at a time and replaced on failure until a decision is reached. This first program in Appendix I simulated the actual operation of a Weibull SPRT "NMAX" times. "NMAX" is a variable which determines the number of Monte Carlo simulations to run for each true value of the scale parameter. The performance of a specific test plan is checked at true parameter values of θ_0 and θ_1. Average test performance can then be computed under H_0 and H_A based on NMAX samples of simulated tests for each true value of θ. For example, if NMAX is 1000, the simulation would conduct 1000 SPRT's to decision for $\theta_1 = 1.0$, and 1000 SPRT's to decision for $\theta_0 = 1.5$. The percentage of errors, average failure number, and test time under each hypothesis are

calculated at the end of each set of simulated SPRT's.

Case II. The program "NONREP" simulates Case II testing. It is the second full program in Appendix I. The subroutine "TESTER" conducts simulations of SPRT's where r_0 items are placed on test without replacement. The failure times produced by the subroutine "VALUS" must be produced in blocks of r_0 failure times sorted from smallest to largest. Again simulated SPRT's are conducted "NMAX" times under each hypothesis.

Case II testing in "NONREP" is the one exception to discrete testing assumptions. In order to calculate the lower limit of Case II test durations, formulas to obtain total test time in the continuous case were used. Callahan has given Eqs (6.9) and (6.10) for calculating continuous decision time (Ref 2:47-48). These formulas are employed after the value of the test statistic crosses an accept boundary and is computed at the next failure point (the SPRT can only reject at a failure point). The test time duration is computed by backing up to the test boundary crossed (in the simulation):

Time truncation:

$$t = \left[\frac{T_0 - V_{r,n}}{n - r + 1} + X_{r,n}^k\right]^{1/k} \tag{6.9}$$

Accept boundary truncation:

$$t = \left[\frac{A_r - V_{r-1,n}}{n - r + 1} + X_{r,n}^k\right]^{1/k} \tag{6.10}$$

where $A_r = rs + h_1$

This procedural correction was only used for time calculations in "NONREP." It was assumed that anyone attempting to use such a test would be interested in the test's best absolute performance in some sense since a prime reason for choosing this test is to decrease test duration. It is hoped these added average time to decision calculations as presented will be most useful to a potential user.

Case III. The program "RPLTABS" is very similar to a typical "queuing system" simulation. In essence, the program is more complicated than the previous two because it must maintain a complete picture of the testing situation both in Weibull time and exponential time. It is more difficult to simulate a Case III test than to run it in practice.

Little more will be said about RPLTABS other than its basic operation. It was assumed that a selection of Case III testing reflects a desire to compress test time. This desire overshadows the need for absolute efficiency of test items. Therefore, the simulated test continues with all test stands in operation until a boundary is crossed or truncation occurs after r_0 failures. The assumption of 100% test stand operation throughout the test was used to simplify programming. Should truncation occur, it is assumed that all test stands less one (NSTAND-1) are in operation at that moment.

In operation, the simulation fills test stands with

test units whose lives are supplied by VALU(INP). Different accumulators keep track of past, present, and future times to failure of test items. A failed item is replaced and V(t) is computed when necessary after each failure. Performance calculations are completed in the same manner as with the previous two cases.

It is hoped these three sections have provided an understanding of the basic assumptions behind the simulations. The next section describes the performance tables themselves.

Performance Evaluations

Monte Carlo Size. A reader might question the reasons for using computer simulations for these evaluations. It is known that Aroian has developed Markov chain evaluations of truncated exponential SPRT's (Ref 35). Could these techniques be used for Weibull SPRT's? The answer is probably yes, but such evaluations are tedious and complicated. Monte Carlo evaluation is a comparatively easy, albeit brute force method for evaluating the performance of truncated tests. Another benefit of Monte Carlo analysis is that it provides a weight of empirical proof along with reasonable evaluations of performance. A purist might object to such brute force methodology, but cannot argue the fact that Monte Carlo simulation is a workable tool of analysis, and, within certain limitations, is an excellent means of evaluating truncated SPRT's.

The sample size (NMAX) is a critical factor in any Monte Carlo evaluation. The cost of a specific simulation in computer time is directly related to the size of the sample. Monte Carlo simulations with sample sizes of 5000 and 1000 were used in this thesis. Previous work by Callahan and Williams employed large scale simulations with 10,000 sample tests represented (Ref 2) (Ref 4). Sample sizes of this magnitude were considered unnecessary for this thesis. It is believed sample sizes of 1000 provide an excellent idea of the performance capabilities of a specific test especially in expected time and failure number calculations. Harter and Moore have used samples of this size very effectively in their recent paper (Ref 3). For simulations where the results are to be used as a more accurate measure of performance, particularly for error values, a larger sample size of 5000 is considered adequate by this author. A figure of 5000 was selected in view of the excessive costs of larger samples in terms of computer production time. It is felt that the loss in accuracy of 5000 samples versus 10,000 samples is minimal.

Since a basic premise of this thesis specifies that truncated SPRT's are essentially equivalent, independent of case testing, large scale (5000) simulations for all forty shape values need only be evaluated for one case. Limited large sample simulations for specified k values can be used for comparison for the other two cases.

Smaller sample (1000) simulations for forty k values were conducted to provide good approximate performance evaluations for Case I and III. Case II was selected for a full evaluation due to its strong analytical base and due to the fact that Case I has been fully evaluated already (Ref 4).

Case II large scale evaluations (40 k values, NMAX=5000) were conducted for the test plans in the appendices. These evaluations were conducted both with truncation multiplication factors of 2.0 and 1.5 for all four risk levels. A potential user has eight evaluated risk alternatives to choose from when selecting a test. Smaller scale evaluations are included for Case I and Case II (NSTAND=2,3,5) using a sample size of 1000 for plans truncated with a multiplication factor of 2.0. These evaluations include the four designated risk levels and include evaluations for the full range of forty k values. The evaluations are included to provide a potential user with a quick reference to discrete performance capabilities available under alternative testing conditions.

Large sample evaluations for a set of ten selected k values are included in Appendix C. These were run for comparative analysis for all three cases. The sample size for these limited evaluations is 5000.

<u>Performance Tables</u>. The performance tables are

included in Appendices A, C, E, and G. There are two similar formats used for the replacement and nonreplacement cases of testing. Examples of the tables are presented in Fig. 12 and Fig. 13. The purpose of this section is to define the entries in the performance tables.

ACCELERATED TEST W/O REPLACEMENT
INPUT ALPHA= .200 INPUT BETA= .200
MULTIPLICATION FACTOR = 10.00 NMAX= 5000

K	ALPHA	BETA	N(0)	N(1)	T(0)	T(1)
.50	.189	.168	45.55	50.23	.039	.032
1.00	.184	.128	13.20	15.01	.216	.148
1.30	.172	.121	8.32	10.09	.351	.236
1.60	.181	.111	6.07	7.29	.477	.305
2.00	.185	.091	4.40	5.25	.620	.385
2.20	.174	.082	3.78	4.55	.682	.416
2.50	.176	.074	3.13	3.83	.750	.458
3.30	.134	.047	2.25	2.88	.938	.583

Fig. 12. Example of an Evaluation Table for Case I or Case III Testing.

ACCELERATED TESTS WITH REPLACEMENT
MONTE CARLO SIZE = 5000
INPUT ALPHA= .200 INPUT BETA= .200
MULTIPLICATION FACTOR= 2.00 NSTAND= 5

K	ALPHA	BETA	N(0)	N(1)	T(0)	T(1)
.50	.211	.189	40.77	44.78	20.002	15.347
1.00	.207	.162	11.59	13.40	3.498	2.683
1.30	.213	.148	7.41	8.67	2.314	1.733
1.60	.225	.143	5.23	5.25	1.762	1.319
2.00	.202	.121	3.69	4.54	1.448	1.039
2.20	.211	.113	3.26	3.98	1.350	.955
2.50	.199	.108	2.74	3.35	1.255	.872
3.30	.193	.092	1.95	2.41	1.129	.737

Fig. 13. Example of Evaluation Table for Case II Testing.

The pertinent information given in the table heading for the replacement case (Fig. 13) is fairly self-explanatory. These entries include the size of the sample used to construct the tabled values, the designated risks used to construct test bounds, the multiplication factor used to truncate the test, and NSTAND, the number of test stands assumed in operation for the test.

The same information is included for the non-replacement (Case II) table heading (Fig. 12). There is the exception that there is no inclusion of the number of test stands operating. For these tables, the number of stands in operation is simply the truncation number for the test, r_0.

The performance entries in the columns are virtually the same for each table. Above each column is a heading which defines the values found in that column. The following are the definitions of the column headings:

<u>K</u>: The assumed shape parameter for the population under test.

<u>ALPHA</u>: The true Type I error calculated in the simulation based on the number of reject decisions made divided by the sample size (NMAX) when the true scale parameter of the population under test is θ_0.

<u>BETA</u>: The true Type II error calculated in the simulation based on the number of accept decisions made divided by the sample size when the true scale parameter in the population under test is θ_1.

<u>N(0)</u>: The average number of failures needed to make any decision (accept or reject) when θ_0 is the true parameter.

N(1): The average number of failures needed to make any decision (accept or reject) when θ_1 is the true parameter.

T(0): The average time required to make a decision when θ_0 is the true parameter. Both T(0) and T(1) are measured in "normal" time units generated by Eq (6.3a) for θ equal 1.5 and 1.0 respectively. To put this value in terms of the MTBF, divide by $\theta\Gamma(1+1/k)$. All times are for discrete simulation with the exception of Case II.

T(1): The average time required to make a decision when θ_1 is the true population parameter. (See T(0)).

It is hoped that Chapter VI has provided the reader with a general familiarity with the methodology used to construct the test plans and evaluations. For examples of how the plans and tables can be used, the reader is directed to Chapter VIII. The next chapter describes some of the analysis using the computer evaluations.

VII. Evaluations of Weibull SPRT Performance

In Chapter VII, a general discussion of the performance of truncated Weibull SPRT's is presented. This discussion is broken down into three parts. The first section is used to illustrate the basic equivalance shared by three cases of testing. In the second part, discussion centers around characteristics of test performance. The analysis includes aspects of testing and changes in performance as the assumed shape changes. The final section provides a brief comparison of Weibull SPRT's with some possible alternatives.

Equivalance

Case I, II, and III Weibull SPRT's appear to be "essentially equivalent" in performance when one standard truncated plan is used for all three cases. The tests are different only in the time required to make a decision and the number of test items actually put into operation (but not necessarily failed). These differences are important from a cost point of view and are examined in Chapter VIII.

The idea of equivalence rests on two aspects of comparison. The first is equal performance with respect to actual risks of Type I and Type II error for any given test. The second is equal performance with respect to actual expected number of failures prior to a decision. Callahan has shown that Case I and Case II are "essentially

equivalent" analytically (Ref 2). This section will present empirical proof of equivalence for all three cases.

To facilitate illustration of equivalent aspects of testing, large sample (NMAX=5000) Monte Carlo simulations were run for ten representative k values. These ten k values were selected because they are spread throughout a reasonable range of k values possible, and are similar to a set of k values previously used in fixed sample testing (Ref 15) (Ref 36:3).

A comparison of performance is illustrated in Table III. Under the performance criteria used to judge equivalence, the different cases appear equivalent. There are virtually no differences either in risks or $E_\theta[r]$ among cases which cannot be attributed to random variation in the Monte Carlo sample. It is believed that a Weibull SPRT plan constructed with previous formulas, and truncated at a specified point, will provide equal risk protection and have the same expected number of failures to a decision regardless of the case testing employed. The two equivalent aspects are independent of the number of items placed on test as long as an appropriate test statistic is used.

The author believes that large scale simulations of Case II testing can be used to predict expected performance of the other two cases. Although it is obvious on examination of Table III that this is not a perfect prediction capability, the author believes that simulations of 5000 sample tests provide close approximations of test performance

Table III.

Comparative Output from Monte Carlo Simulations

Sample Size=5000 $(\alpha=\beta=.10)$

Output with θ_0 True Population Parameter

	True Alpha (Simulated)				True Failure Number (Simulated) to Decision			
k	Case I	Case II	Case III n = 2	Case III n = 5	Case I	Case II	Case III n = 2	Case III n = 5
.50	.112	.112	.104	.113	82.29	81.05	82.97	82.05
1.00	.107	.118	.114	.115	21.55	21.78	21.76	21.78
1.30	.114	.112	.117	.112	13.39	13.32	13.16	13.29
1.60	.111	.110	.107	.109	9.21	9.39	9.16	9.17
2.00	.107	.111	.104	.109	6.19	6.24	6.22	6.24
2.20	.103	.100	.106	.117	5.36	5.34	5.22	5.40
2.50	.097	.103	.101	.097	4.27	4.35	4.36	4.31
3.30	.100	.092	.096	.105	2.77	2.76	2.79	2.81
4.30	.086	.080	.085	.086	1.99	1.97	1.98	1.96
5.70	.062	.063	.071	.066	1.48	1.51	1.52	1.50

Output with θ_1 True Population Parameter

k	True Beta (Simulated)				True Failure Number (Simulated) to Decision			
.50	.113	.109	.112	.108	91.10	89.77	91.59	92.14
1.00	.082	.088	.086	.089	25.59	25.68	25.75	25.61
1.30	.082	.077	.078	.082	16.39	16.40	16.39	16.26
1.60	.075	.072	.075	.072	11.59	11.47	11.52	11.64
2.00	.067	.065	.070	.067	8.16	8.28	8.07	8.14
2.20	.060	.067	.057	.059	6.97	6.88	6.99	6.97
2.50	.046	.057	.054	.049	5.85	5.84	5.86	5.83
3.30	.042	.046	.041	.043	3.87	3.90	3.84	3.83
4.30	.032	.039	.031	.037	2.76	2.76	2.75	2.78
5.70	.020	.018	.018	.019	2.10	2.11	2.10	2.11

and are useable in a variety of testing situations. For example, referring to Table III, if one desired risk protection of .10 for both α and β for testing a population with a shape of 2.5, the tabled value is ample justification for use of a Weibull SPRT if minor deviations from the desired risk are acceptable.

Performance Evaluation

The evaluations of this section are based on simulations with a sample size of 5000. The discussion is divided into three main areas of interest; actual risk performance, theoretical versus actual number of failures to decision, and time compression aspects among the three cases of testing.

Actual Risk Performance. These evaluations are based on simulations of truncated Case II SPRT's with a sample size of 5000. The intent is to portray the interesting behavioral aspect of increasing discrimination as the shape parameter increases.

Fig. 14 depicts a plot of experimental actual performance in terms of alpha and beta error for a test truncated at $2E_{\theta_1}[r]$. The designated error indicated by the dashed line is .10.

The plot in Fig. 14 is typical of all the SPRT's which were simulated. One notices immediately the almost linear relation between actual error and population shape parameter. This is particularly evident for Type II error. One can also see bias toward beta error for a

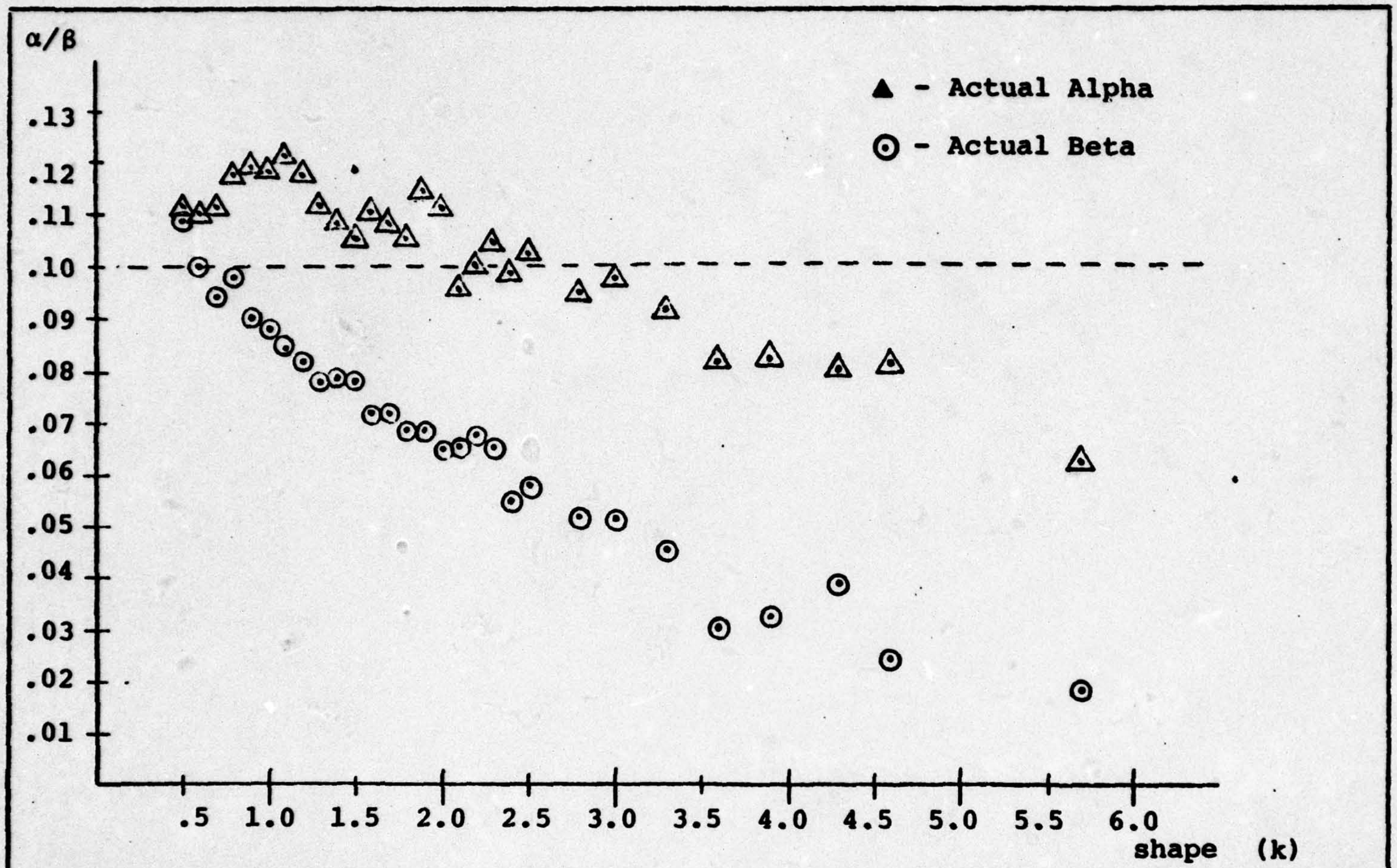

Fig. 14. Actual Risk Values for a Case II Weibull SPRT Truncated at $2E_{\theta_1}[r]$ Plotted Versus Shape Parameter.

truncated test. The discrepancy between alpha and beta error appears to widen as k increases. The exact reason for this bias is not known. It appears to be a product of right angle truncation as Harter and Moore have shown more comparable values for alpha and beta for a simulated untruncated test (Ref 3:103).

The reader will notice that the performance of the test is best in some sense in a k range from 1.0 to 3.0 approximately. By adjusting the truncation point, it is possible to shift the range of acceptable performance further along the k axis. Williams has shown that variations of this sort can be used effectively in modifying actual error performance. Fig. 15 illustrates this point. A truncation point of 1.5 $E_{\theta_1}[r]$ provides for more acceptable performance in the higher k range. This is the reason behind inclusion of large scale analyses for truncation points with multiplication factors of 2.0 and 1.5 in the appendices. The user has the option of selecting a test best suited to his particular desires. Using the shorter truncation of 1.5 is also more economical as it provides for less expenditure of test units. The full test plans in the appendices can be easily modified for a 1.5 multiplier by making minor modifications using previous formulas.

Expected Decision Number. The simulated expected number of failures required to make a decision conforms

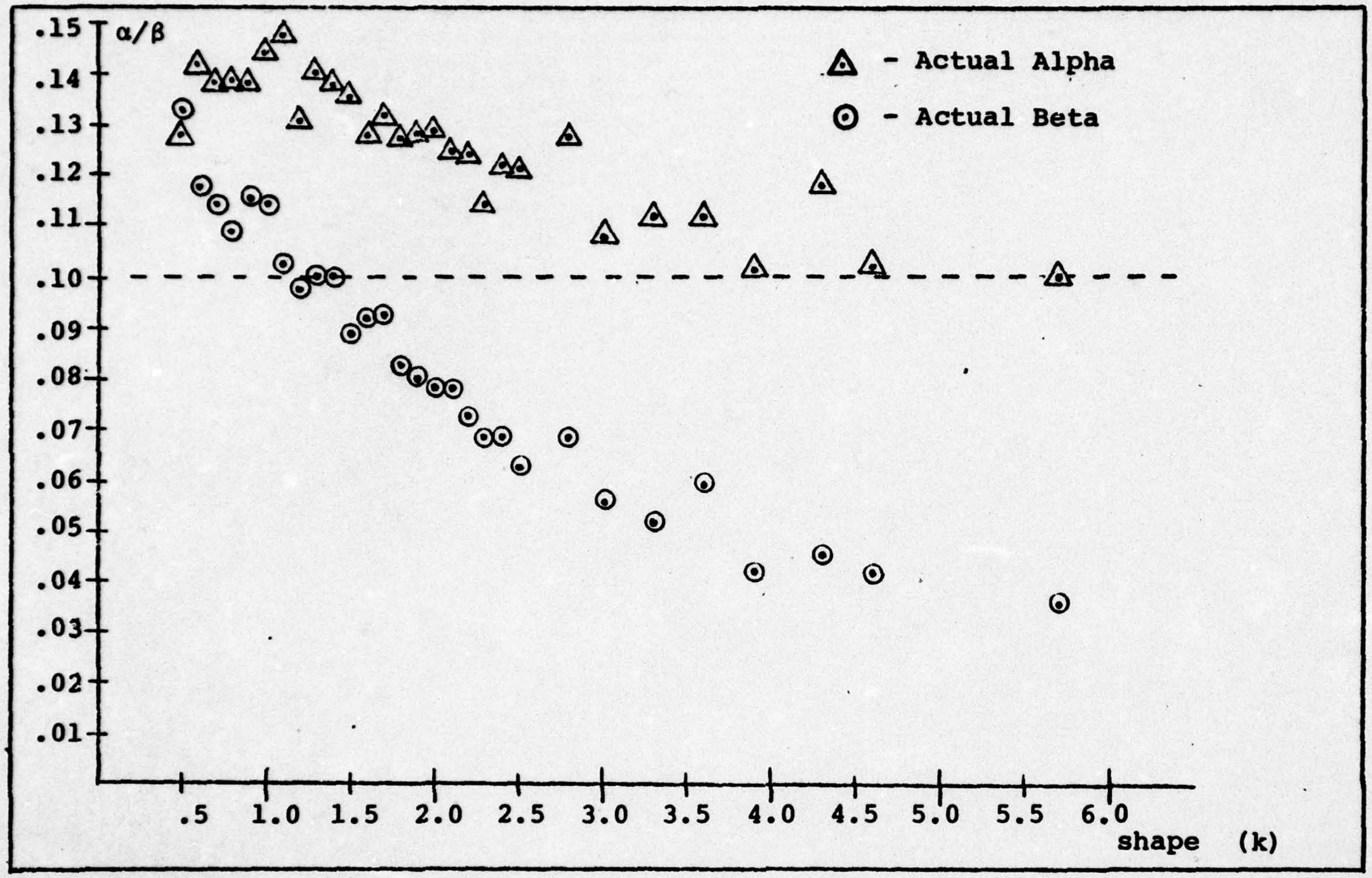

Fig. 15. Actual Risk Values for a Case II Weibull SPRT Truncated at 1.5 $E_{\theta_1}[r]$ Plotted Versus Shape Parameter.

almost exactly to the theoretical value when a truncation multiplier of 2.0 is used. For a truncation multiplier of 1.5, there is a larger difference between theoretical and actual values of $E_{\theta}[r]$ at low k values. The discrepancy decreases rapidly as k increases. Table IV is illustrative of differences among the three values for $E_{\theta_1}[r]$. The reader will notice that the performance of both truncated tests is very close to theoretical. Much of the differences can be explained by the differences between discrete and continuous testing.

The excellent performance of standard plans truncated with a factor of 2.0 is shown in Fig. 16. The curved line represents the theoretical expected number of failures to a decision given θ_1. Each square represents a data point from a Monte Carlo simulation with a sample size of 5000. The graph helps to emphasize the dramatic decrease in expected failures as k increases for the same designated risks. The curve in Fig. 16 is typical to Weibull SPRT behavior at all risk levels. It is interesting to note that a mere change in assumed k from 1.0 to 1.5 cuts the expected number of failures required to a decision by approximately fifty percent. This is an important aspect of Weibull SPRT's, particularly since it might dissuade those who are inclined to make out of hand assumptions of exponentiality by assuming k equal to one.

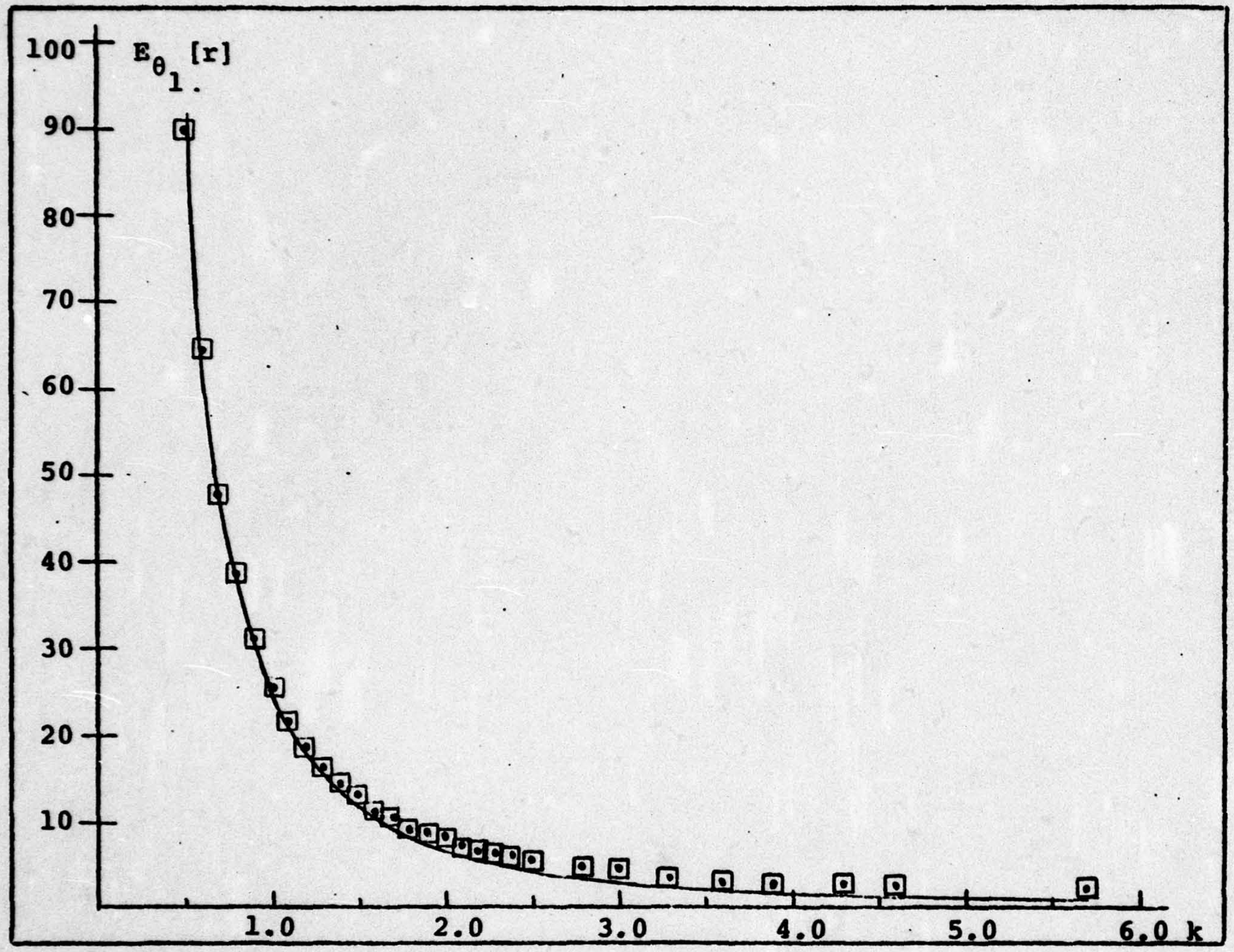

Fig. 16. Expected Number of Failures to Decision. Theoretical versus Simulated Given θ_1 Plotted Against Shape Parameter.

Table IV. Comparison of Expected Decision Number $\theta=\theta_1$ $\alpha=\beta=.10$			
k	Theoretical	Experimental Factor=2.0	Experimental Factor=1.5
.50	91.41231	89.77	82.61
.60	64.31275	64.29	44.47
.80	37.12056	38.38	35.07
1.00	24.36901	25.68	23.67
1.20	17.35278	18.54	17.28
1.50	11.52425	12.95	11.93
2.00	6.88314	8.28	7.58
2.50	4.66812	5.84	5.45
3.00	3.42853	4.45	4.27
4.30	1.91394	2.76	2.52
5.70	1.24639	2.11	1.87

<u>Time Compression</u>. After a particular Weibull SPRT plan is chosen, the decision of which case of testing to use rests on the need to compress time.

A Case I test has the longest expected clock time to a decision. Case II and Case III testing can be theoretically accelerated as much as desired if enough test stands and test items are available. For an equal number of test stands Case III will be the fastest test available. For a given number of test items, all of which can be tested simultaneously, Case II is the fastest test available.

The expected time to a decision for a Case II test

is simply the expected value of the $E_\theta[r]$th order statistic out of the n on test. A general formula is available for the expected time to decision for Case I and III, the replacement cases:

$$E_\theta[t] = \frac{E_\theta[r]}{n'}\,\theta\Gamma(1 + 1/k) \qquad (7.1)$$

where n' = # of test stands.

One can see in Eq (7.1) that as n' increases, expected time to a decision decreases toward zero. Unfortunately tests using large values for n' are generally costly in practice and impractical to administer in many cases.

Fig. 17 helps to illustrate some of the options in time compression open to a prospective user of a Weibull SPRT. The points on the graph are data points generated from simulations in this thesis. The curves are drawn to accent the rapid decrease in expected test time to decision as k increases for different testing situations. The spacing between the curves helps illustrate the time savings which can be gained using a relatively low number of test stands. One also notes that as k increases the relative benefits of accelerated testing decrease.

The reason for including small sample evaluations for replacement testing cases becomes clearer. Evaluations are provided for 1, 2, 3, and 5 test stand operations. These tables can be handy reference for approximate time to decision values. They can also be used for cost analysis of test options. For test options not tabled,

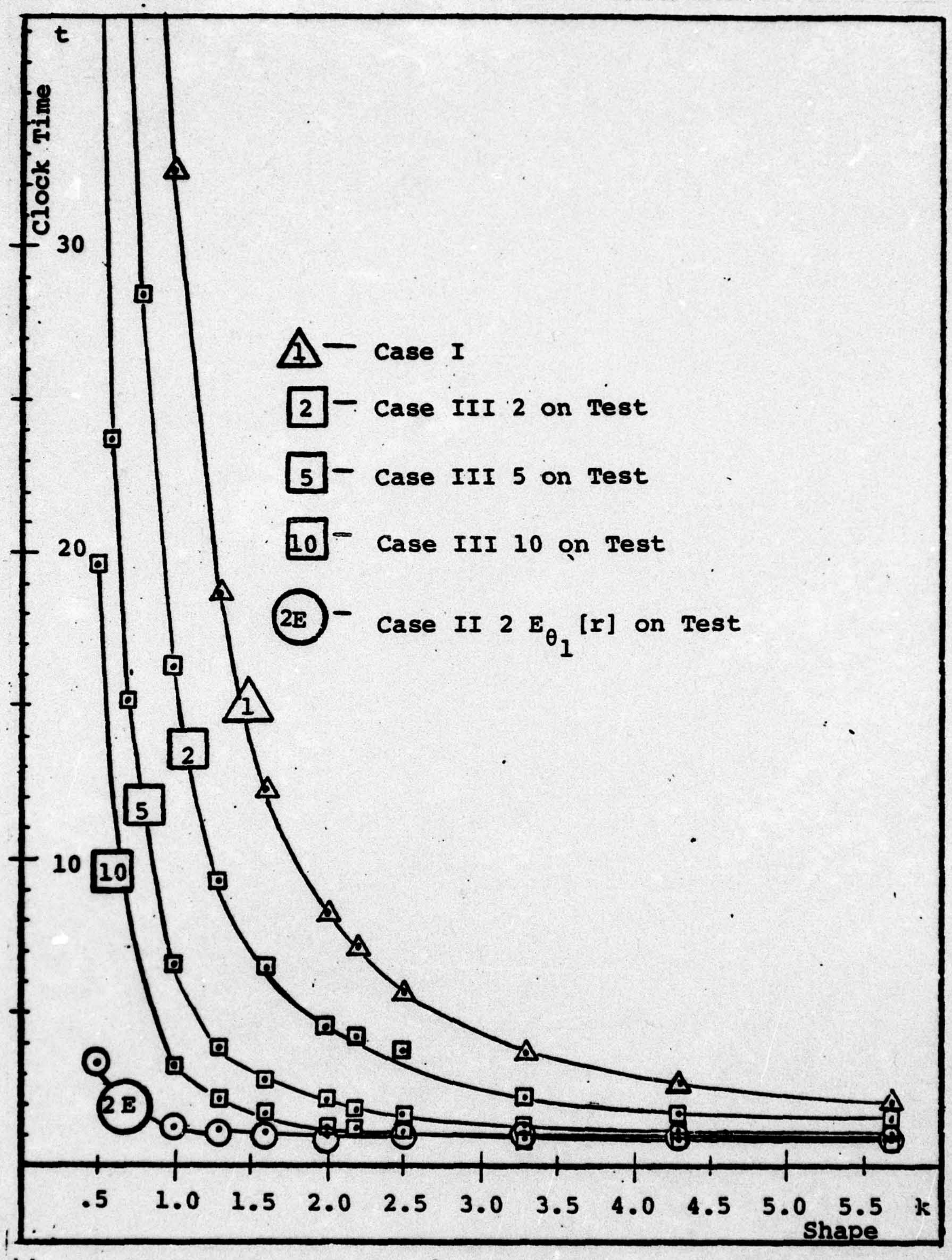

Fig. 17. Expected Time to Decision For Selected Test Configurations Plotted Against Shape Parameter ($\alpha=\beta=.10$).

good approximations of test performance can be attained using continuous formulas.

The point that should be made is that the decision of which case testing to use is an economic decision. How to make that decision is discussed in Chapter VIII. By examining Fig. 17, the reader can observe some of the capabilities open to him. It is really difficult to say which test performs best in some sense because that "best" is fully dependent on the specific conditions of the testing situation. Theoretically a wide range of testing opportunities is available, one must simply use the one most favorable to one's desires.

<u>Weibull Versus Exponential SPRT's</u>. It is possible and convenient, in pursuing life testing objectives, to assume that the underlying distribution for failure in a population is exponential. Once that assumption is made, considerable analytical support is available to use in testing hypotheses. In many cases such an assumption seems to be similar to looking for a lost set of car keys under a street lamp when it is known that they may have been lost in the dark fifty feet away. It is simply easier to conduct the search in the light.

The error of the exponential assumption can be both dangerous and costly when the true distribution is Weibull with k unequal to one. Some research has been done in this area. Zelen and Dannemiller have shown that exponential

tests are definitely not robust to the exponential assumption. They have stated:

> ... in practical situations it is rare to have enough data to verify whether the exponential failure law is actually the failure law characterized by the data. Instead we actually assume that the exponential failure law is the "correct" law and use techniques based on the exponential distribution [Ref 37:185].

When these authors used a Weibull population with a shape of 2.0 to check an exponential SPRT it was found that the exponential SPRT was extremely conservative (Ref 37:187).

Recently, Harter and Moore examined the robustness of MIL-STD-781-B test plans (Ref 3). Their results have shown that exponential SPRT's are basically conservative (provide lower than desired risks) for shape parameters greater than one and that actual risks of making an error are higher than designated for k less than one (Ref 3:101). These authors state,

> It is clear that use of test plans assuming an exponential distribution of life can be fraught with serious consequences for even small departures from that assumption. So these plans should not be used unless there is strong theoretical and/or historical evidence that the life devices of the type being tested really do have an exponential distribution [Ref 3:101].

What are these "serious consequences?" It is interesting to make a few statements in terms of cost. When k is less than one, use of an exponential plan increases a risk of error and increases the expectation of incurring costs connected with that error. When k is greater than one, there is a waste cost incurred. This waste cost may be in the form of excess expenditure of test units or

test time. The waste may be incurred in making budgeting errors. If one assumes an exponential distribution, when in fact the underlying distribution is Weibull with a k larger than one, the budgeted cost of a testing program may be far greater than necessary. Beyond budgeting, the user may be buying unnecessary or even unwanted quality assurance.

Recalling a previous example, a movement of k from 1.0 to 1.5 decreased expected number of failures by one half. By assuming exponentiality, one would have to budget for the larger failure number and risk undesired quality assurance in the bargain. It appears that Weibull SPRT's can be more cost effective alternatives than exponential SPRT's when the underlying distribution is Weibull. From a pure cost point of view, it appears savings can result through use of plans in this thesis when the failure is Weibull distributed.

<u>SPRT's Versus Fixed Sample Tests</u>. Goode and Kao have developed attributes sampling plans for tests which specify the Weibull distribution. Their plan is constructed to make a decision at or before some specified time based on the number of failures observed from a fixed sample (Ref 15). It is of interest to briefly compare a few of these plans with SPRT's presented in this thesis.

Though a direct comparison between plans with the same designated risk is difficult, the potential user can get a

feel for the exceptional power available when using Weibull SPRT's by examining Table V. Weibull plans with designated risks of .05 were compared with fixed sample plans presented by Goode and Kao. Tests were selected for approximately equal decision time. In general, the Weibull SPRT's have the same or better approximate risks than the fixed plans. The expected time to rejection given θ_1 is approximately the same as the specified time for the comparable fixed tests. The expected time to accept when θ_0 is the true parameter is slightly longer for the Case II tests represented than for the fixed tests.

The sample size is comparable in magnitude between the two. The reader should note that increases in SPRT samples would serve to decrease expected time to decision while $E_{\theta_1}[r]$ remains constant. It appears that there is a clear superiority in SPRT testing over these fixed sample tests, however, that superiority diminishes for large discrimination ratios and/or large k values.

The experimental values listed for $E_{\theta_1}[r]$ are from discrete simulations. Further superiority of Weibull SPRT's over these fixed plans could be demonstrated by using continuous testing procedures.

A full analysis of comparative efficiency of Weibull SPRT's is not in the scope of this thesis. It has been stated that exponential SPRT's have approximately 40% greater efficiency than fixed length plans in MIL-STD-781-B (Ref 3:101). One believes that similar savings

Table V.

A Comparison of Performance Between Select

Weibull Fixed Sample Tests and Case II Weibull SPRT's

Truncated at $2E_{\theta_1}[r]$

K Fixed / K SPRT	Discr Ratio	Fixed α/β	Exp SPRT α/β	Fixed Sample Size	Fixed Reject Number	SPRT Sample Size	$E_{\theta_1}[r]$*	t** Fixed	$E_{\theta_1}[t]$*
.5 / .5	4.8	.05 / .10	.058 / .039	25	15	23	12.47	2.00	2.26
1.67 / 1.70	1.5		.059 / .038	39***	18***	28	14.85	.89	.894
2.0 / 2.0	1.5		.059 / .041	36	15	21	11.48	.89	.899
2.5 / 2.5	1.5		.048 / .030	25	9	15	8.08	.89	.868
3.34 / 3.30	1.5		.044 / .025	16	5	9	4.98	.90	.900

* Experimental (Discrete)
** Approximate Time to Decision
*** Approximate Value

are possible with Weibull SPRT's. It is assumed that significant savings can be achieved when Weibull SPRT's are used for populations whose lives are either characteristically very good or very bad. It should be noted, however, that the relative merits of Weibull SPRT's over fixed length tests seem to decrease somewhat with large shape parameters and/or large discrimination ratios specified in testing. The capability to discriminate between two populations increases in those areas and the greater simplicity of fixed testing may win out over marginal gains achieved by employment of Weibull SPRT's. It must be emphasized that a potential user of Weibull SPRT's should evaluate all alternatives in terms of costs and risks before opting for any one plan. It is believed there are numerous instances where Weibull SPRT's will prove to be highly efficient choices.

VIII. Weibull SPRT Selection From a Cost Viewpoint (With Examples)

The author presents a rationale for selecting the configuration best suited to a Weibull SPRT in this chapter. Generally, criteria for choosing a test configuration are the same as those one would use in designing a test for an exponential population using MIL-STD-781-B.

There are really only two types of Weibull SPRT's. The three case development was presented primarily as a means of simplifying explanations of test statistics. The two classes of testing are independent sample (replacement) testing and dependent sample (non-replacement) testing. Each class represents a wide range of test stand and test item configurations which can be used to achieve varying degrees of time compression. The question examined in this chapter is which configuration will provide the least cost testing alternative for a prospective testing program.

The analysis examined in this chapter concerns the achievement of some risk protection level (which is fixed and known) at the least cost in some sense to the testing agency. Since the risk is fixed, the question is which version of a specific truncated SPRT should be used in a testing program. The answer to that question rests on finding the optimum combination of items on test which will provide the desired risks at the least cost.

J. M. Moog has explored the topic of optimum number of test units to place on test when using SPRT's from MIL-STD-781-B. His primarily graphical analysis centers on the optimum number of units to place on test for a specific test plan given various possible true values of the MTBF. That author's examination has pointed out certain relationships between testing costs and the optimum test number (Ref 38). The following analysis is similar to Moog's discussion in some respects, but the intent is to provide the user of Weibull SPRT's with an illustration of how the optimum test configureation can be obtained (or at least illuminated) using a simple cost model.

Assumptions

In order to construct any cost model it is first necessary to make some basic assumptions. For example, the model assumes that risk level (true α and β) are specified and constant. The assumption is also made that only long run results are applicable to the model. For that reason, expected value formulations are assumed relevant and perfectly adequate for projections where available. One can imagine that test costs being evaluated are long run costs based on numerous repeated prospective SPRT's. In a later example it will be indicated how a user may hedge against variability in testing outcome costs.

The model also assumes that some good idea of testing costs can be "broken out" by the testing agency. This is a

big assumption as the reader will soon note that some of the cost coefficients may not be easily derived by the average organization (Ref 38:52).

Another basic assumption before beginning explanations is that low monetary cost is a relevant criteria with which to judge an optimum test configuration. This may not always be the case of course. There are conceivable cases where test duration is the only relevant factor in choosing test configuration.

Since there are only two basic cases of Weibull SPRT's, it is possible to evaluate the best test for both types and then select the optimum choice by comparison. The case where a dependent sample is placed on test without replacement is somewhat unique. This case is unique in that there are some particular considerations which predispose one toward use of this test such as its relative simplicity when compared with the replacement case, the ability to place a large number of items on test, and time compression capability. One can make the assumption that when this type test is used there are usually a limited number of feasible alternatives to consider. Each of these may be evaluated for cost independently since dependent testing is not as conducive to analytical techniques as is the replacement case. It is possible to formulate a cost function for the replacement case which can be evaluated as a continuous function in terms of the number of test stands in operation.

It is assumed that the difference between discrete and

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continuous testing has little effect on determining the optimum number of items to place on test. To facilitate formulation and explanation, only continuous testing will be completely analyzed.

It is possible, however, that discrete testing will change the optimum solution to some extent. The potential user should consider the effects of discrete testing on the outcome of a cost analysis where possible. Discrete testing evaluations presented in the appendices may be helpful in checking true optimality of some solutions.

The Model

Cost Elements

This section contains definitions of separate cost elements used to make up the test model. Though they may not include all possibilities, the cost coefficients presented represent a basic example of costs which should be considered by the testing organization. In the following discussions, the variable n' is used to indicate the number of test stands in operation.

C_{SU}: Start Up Cost. The start up cost is some fixed amount incurred at the beginning of a test. It may be small, or, in some cases, may involve significant outlays.

C_{TS}: Cost Per Test Stand. This may be considered as an acquisition cost of setting up the test which is related directly to the number of test stands ($n'C_{TS}$).

C_O: Overhead Cost Rate. Overhead costs are incurred at a rate per unit of time. In this case C_O is expressed in terms of the same unit base as MTBF. The overhead may include numerous costs such as utilities, personnel and rental costs. Overhead costs are incurred as a direct outcome of expected clock time for the test to run $(E_\theta[t]C_O)$.

C_{TSO}: Overhead Rate Per Test Stand. This is a time rate which allocates costs relative to the number of test stands $(n'E_\theta[t]C_{TSO})$. The formulation may be slightly different for a dependent sample since all test stands do not necessarily operate for the duration of the test. $[f(n',E_\theta[t])C_{TSO}$.

C_{FI}: Cost per Failed Item. When an item actually fails, there is some cost incurred. If it is destroyed, it may be disposed of, or it may only need repair. In a Weibull SPRT, this cost is independent of the number of items on test. $(E_\theta[r]C_{FI})$.

C_{NFI}: Cost of a Non Failed Item. Whenever an item is placed on test and operated, it is assumed some cost is incurred even though the item has not failed when a decision is reached. The cost may involve replacement, repair, or inspection procedures. This cost does depend on n' and the type of testing:

Discrete Replacement: $C_{NFI}(n'-1)$

Continuous Replacement: $C_{NFI}(n')$

Continuous Nonreplacement: $C_{NFI}(n'-E_\theta[r])$

Total Cost

It is now possible to combine the above costs into a total cost model. Consider for the continuous replacement case:

$$C_{TOT} \approx C_{SU} + n'C_{TS} + n'E_{\theta}[t]C_{TSO}$$
$$+ E_{\theta}[t]C_O + E_{\theta}[r]C_{FI} + n'C_{NFI} \qquad (8.1b)$$

A slightly different formulation exists for a dependent sample:

$$C_{TOT} \approx C_{SU} + n'C_{TS} + f(n',E_{\theta}[t])C_{TSO}$$
$$+ E_{\theta}[t]C_O + E_{\theta}[r]C_{FI} + (n'-E_{\theta}[r])C_{NFI}. \qquad (8.1b)$$

Cost Minimization

The total cost of testing for the continuous replacement case can be minimized by selecting the optimum number of test stands in operation. By taking a derivative of Eq (8.1a) with respect to n', setting the result equal to zero and solving for n', an optimum number of test stands can be found to minimize cost.

$$n^* = \sqrt{\frac{E_{\theta}[r]\theta\Gamma(1+1/k)C_O}{C_{TS} + C_{NFI}}} \qquad (8.2)$$

It can be shown that the n* satisfying Eq (8.2) satisfies the requirements for a universal minimum. Unfortunately, the assumption is implied that the cost function is differentiable. Though this is not the real world situation, it is possible to use the result, n*, as an indication of the minimum cost vicinity on the cost curve. The minimum cost integer n' must lie on either side of the value n* on the cost curve.

It is important to note that the optimum number of items on test is directly proportional to the square root of a cost ratio for a given test and specified population. Where R is a constant for a given test:

$$n^* = R \left[\frac{C_O}{C_{TS} + C_{NFI}} \right]^{1/2} \tag{8.3}$$

The appeal of Eq (8.3) is in identifying how n* behaves as costs of testing change. In effect, as overhead cost rates rise, the number of items desired on test at one time increases to provide more time compression, however, as the acquisition costs of test stands and/or the cost of nonfailed items increase, the desired number of items on test decreases.

This model is presented as an example of a cost relationship. A user of Weibull SPRT's may find it necessary to modify it considerably; however, the basic results still hold. The higher the overhead rate, the greater the cost pressure to reduce test time. The greater the expenses of using additional items, the greater the cost pressure to reduce the number of items on test. The expected number of failed items (and hence the costs of those failures) are independent of the test configuration.

Given a true value of θ, it is possible to set up a test which is best suited for a population with that θ. Even though the test is constructed between θ_0 and θ_1, other values of θ could be included in the cost analysis. The testing agency could configure a SPRT to take advantage of cost benefits if it is believed that a given lot has

some particular value of θ. Moog has built an analysis around this point indicating that it is possible for a producer to limit testing costs by using the optimum number of test stands for the believed true value of the MTBF in exponential SPRT's (Ref 38).

At this point it may prove helpful to present examples of testing situations which will illustrate selection of a proper Weibull SPRT to employ in a given situation.

Examples

Example One

An engineer wishes to test a hypothesis that a particular production lot of bearings has an acceptable MTBF. It is known that the process used to construct the bearings either produces good quality bearings or poor quality ones and for some reason the populations are almost always dichotomized in this way. The engineer selects a Weibull SPRT because it is ideal for this purpose. The consumers have assured the producing corporation that any bearings having a MTBF of 150 hours or better are perfectly acceptable. Units with MTBF below 100 hours are definitely not acceptable.

It has been determined that special bearings of this type have failure times which can be described using a Weibull distribution with k of 1.6. Through negotiation with potential consumers, it has been decided that a Weibull SPRT with designated risks of .10 truncated at $2E_{\theta_1}[r]$ is

acceptable for testing purposes.

The engineer expects to be using the test numerous times in the months ahead and believes a test selected on a minimum expected cost basis is desirable. Corporate controllers have recently provided a cost data sheet for different departments to use when operating the company's multi-purpose test facility. These cost allocations have been figured so that the numerous departments in the organization will budget their testing requirements in a least cost optimum fashion.

The initial set up costs for the testing amount to one hundred (100) dollars. For this particular test, special test machines must be moved in from another part of the plant and then calibrated prior to operation as test stands. It takes approximately fifty (50) dollars (C_{TS}) to accomplish this for each test stand. While operating, however, the test stand overhead allocation is negligible ($C_{TSO}=0$). The testing facility is charged to the production departments at a rate of three (3) dollars per test hour (C_O). Since the bearings are a special high temperature carbon lubricated type, the failure cost is one hundred (100) dollars each. However, items which are tested but do not fail can be refurbished at a cost of fifty (50) dollars each (C_{NF}).

The cost function can be constructed using Eq (8.1a):

$$C_{TOT} = 100 + 50n' + \frac{3E_\theta[r]\theta\Gamma(1 + 1/1.6)}{n'}$$

$$+ 100E_\theta[r] + 50n' \qquad (8.4)$$

$$E_{\theta_1}[r] = 10.25$$

$$E_{\theta_0}(r) = 8.83$$

Using Eq (8.2):

$$n^*_{\theta_0} = 6.3 \qquad n^*_{\theta_1} = 5.54$$

It is possible to calculate the actual cost in the vicinity of n^*_θ to find the optimum cost points:

$$n'_{\theta_0} = 6; \; C^*_{TOT} = \$2245.25$$

$$n'_{\theta_0} = 7; \; C_{TOT} = \$2250.64$$

$$n'_{\theta_1} = 5; \; C_{TOT} = \$2240.00$$

$$n'_{\theta_1} = 6; \; C^*_{TOT} = \$2237.50$$

In this case, since the engineer has knowledge of the dichotomized nature of the usual production output, he selects n' as six. To get a better understanding of the cost behavior of the model it is possible to investigate all cost points in the vicinity of the optimum. Such a graph is presented in Fig. 18.

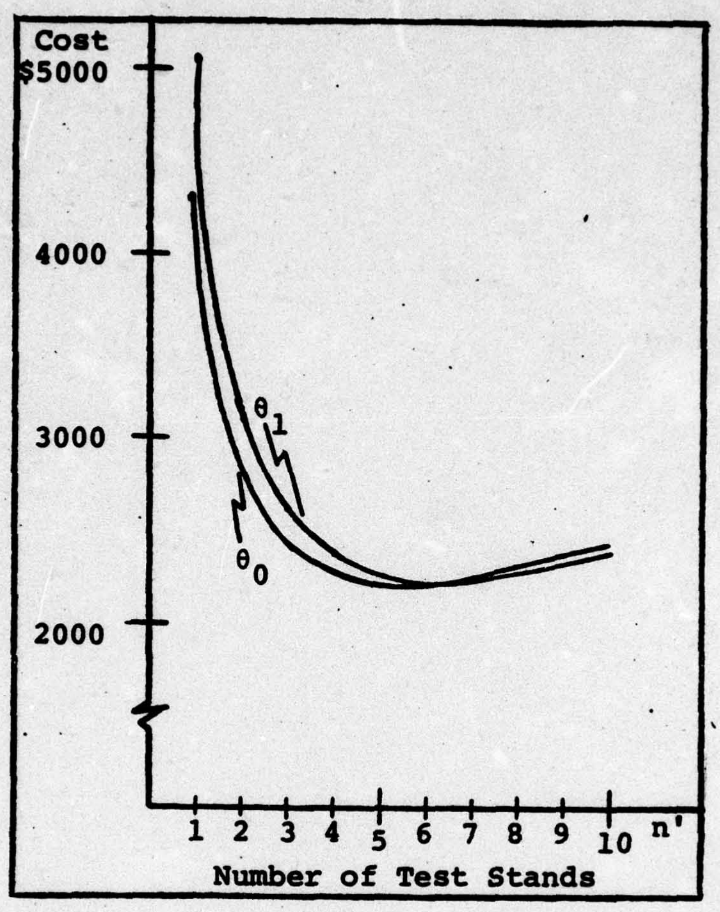

Fig. 18. Cost Comparisons for Various n' Under θ_0 and θ_1.

In this specific case, one notes that expected costs rapidly decrease as the number of test stands goes from one to four. Beyond the minimum cost points, the curves are relatively flat. Such cost behavior presents the testing agency an opportunity to hedge against some of the variability expected in testing costs. One assumes that as the number of test items increases, time to decision compresses as does time variability. Since the costs incurred by increasing the number of test stands are small,

the engineer may be able to reduce variability in testing costs by simply increasing the number of units on test.

At this point, the engineer could examine the possibility of dependent testing. It might be reasonable to assume he does not wish to go beyond the $2E_{\theta_1}[r]$ sample size (21). By examining the evaluation for such a test in the appendices:

$$T(0) = 1.288$$

$$T(1) = .946$$

Converting these values to multiples of $MTBF_\theta$:

$$E_{\theta_0}[t] = \frac{1.288}{(1.5)\Gamma(1+1/1.6)} \simeq .98\ MTBF_{\theta_0}$$

$$E_{\theta_1}[t] = \frac{.944}{(1.0)\Gamma(1+1/1.6)} \simeq 1.03\ MTBF_{\theta_1}$$

$$E_{\theta_0}[t] = (.98)(150) = 147$$

$$E_{\theta_1}[t] = (1.03)(100) = 103$$

By substituting in Eq (8.1b) one can find an approximate cost figure for dependent sampling when twenty-one test stands are operating initially:

$$C_{TOT_{\theta_1}} = \$3021.50$$

$$C_{TOT_{\theta_0}} = \$3082.50$$

If dependent sample testing were a valid alternative (if 21 test stands were available etc.) it can be seen that

the expense is much greater than the minimum cost independent testing alternative. Due to the nature of costs in this example, it is unnecessary to explore costs of dependent testing further.

The engineer makes the decision to use six test stands simultaneously. Since θ_1 equals approximately 111.6 hours, each test boundary value in test plan "II-23" should be multiplied by $(111.6)^{1.6}$ to modify the plan so that the actual test failure times may be used in the test statistic computation (V(t)). As each bearing fails, it is replaced by a new one. A decision is made when the test statistic for Case III testing crosses one of the modified boundaries. From the performance evaluation tables, one would expect true error protection to be in the vicinity of .110 and .072 for alpha and beta respectively.

<u>Example Two</u>

It is possible to modify the preceding example to illustrate the effect of costs in influencing selection of a test configuration. It so happens that a new bearing has a Weibull distributed failure life with the same k as the previous example. Unfortunately the test requirements for the new bearing demand that the new bearing be tested under actual conditions in a jet engine. In this case it can be assumed that test stand acquisition costs for the new test have a tendency to skyrocket over the cost of the previous testing machine. Since this new bearing is undergoing development,

it can be assumed that whether it fails or not there is considerable cost to the testing agency. The situation as constructed is an idealized example which might force the testing agency to opt for Case I testing.

Assuming that specified MTBF's remain the same, and that overhead rate does not change, it is possible to examine the formula for n* to determing what values C_{NF} and C_{TS} must assume to make Case I testing worthwhile:

$$n^*_{\theta_1} = \sqrt{\frac{(150)(3)(8.83)}{C_{NF} + C_{TS}}}$$

For a $n^*_{\theta_1}$ to be equal to one the sum of $C_{NF} + C_{TS}$ must equal \$3973.50. If the denominator costs are in that vicinity, the testing agency may find Case I testing the best alternative. One might believe the overhead rate seems extremely low for the example. In this instance, an increase in overhead rate has considerable effect on the n* desired. By playing with the cost figures, the reader can better understand the relationships between costs and n*.

The end result of this small exercise is that even with low overhead rates it is possible that test stand and/or unfailed item costs may need to be fairly large to justify Case I testing. It is important to emphasize here that the number of failures is independent of type testing employed so that failure costs do not influence a choice of n*. In the extreme, if there are no costs for test stand acquisi - tion or nonfailed items, it behooves the testing agency to place as many items on test as possible.

Which test one uses must always depend on the risks and prospective costs one is willing to assume in the testing program. It is hoped that this chapter has given the reader some insight into the problem of test configuration selection as it relates to Weibull SPRT's. The cost of a testing program is almost always a relevent consideration in choosing a test configuration. The author believes that accelerating a test as much as possible at any cost is a seldom used alternative. If nothing else, knowledge of the minimum long run cost configuration will give decision makers a point of reference from which they may more directly influence profitable outcomes of testing programs.

IX. Conclusion

Summary and Conclusions

Weibull SPRT's have behavioral properties very much like those displayed by exponential SPRT's. In general, it is believed a test plan with boundary values given at various failure points can be used with any test configuration as long as the test statistic represents the summation of test time (on each item) transformed by the kth power transformation. Three cases or types of testing configurations have been presented. A test statistic, V(t), is available for each case. In general, there are really two types of testing, replacement and non-replacement.

It has been shown that an "essential equivalence" exists among all three cases. Tests that are truncated at the same point should have the same actual risks regardless of the actual test configuration used. The expected number of failures to a decision is always the same for a given value of θ and is independent of the test configuration. The configuration does have a great deal of effect on the expected time to decision for various cases.

The Weibull SPRT has some interesting characteristics. As the shape parameter increases, it is easier to discriminate between two given scale parameters or MTBF's. This discrimination capability shows up in both decreases in time to decision and expected failure number as k increases.

Conversely as the discrimination ratio increases for constant k, it is assumed that similar discrimination power increases would result due to the nature of standard test plan equivalence discussed in Chapter V.

It is believed that a Weibull SPRT has a definite value when compared with testing alternatives such as the exponential SPRT or Weibull fixed sample tests. The need to evaluate alternatives thoroughly is paramount before beginning any testing program.

There are numerous test configurations which can be employed for any given Weibull SPRT plan. The "best" solution may not always be evident, but it is possible to conduct a testing program at considerable savings to the testing agency if some form of cost analysis is conducted to determine the optimum cost of a program in terms of dollar costs or risks. It is hoped that the examples in Chapter VIII are helpful in clarifying the cost relationships involved in testing.

The author believes that the results of this thesis, and previous work by others in the field of Weibull SPRTs, will help to promote more widespread use of the test. The presentation of truncated evaluated plans should help to alleviate some of the computational hinderances which may have prevented use in the past. It is believed that the concept of a Weibull family of SPRT's will help to promote improved capability in reliability testing.

Recommendations

Weibull SPRT evaluation can be expensive and time consuming even with the use of a modern computer. During preparation of this thesis the author believed that a sample size of 5000 was sufficient for Monte Carlo investigation. Under time and cost constraints for an investigation at this level, the author believes this to be a valid assumption; yet full evaluation of Weibull plans can still be beneficial.

It appears that MIL-STD-781-B sequential test plans are really only a minor subset of a broad range of possible Weibull plans. If possible, a set of truly standard plans should be developed for a set of Weibull distributions in a similar manner. If necessary, the number of k values for such a new standard could be reduced from the forty presented in this thesis. "Optimum" boundaries such as those for the current standard can be constructed for Weibull plans. This would improve desired performance considerably over the simple "right angle" truncated plans presented here.

It is also hoped that researchers in the field will begin to use Weibull SPRT's. Such usage could help considerably by providing the feedback necessary to develop the plans into easy to use, efficient tools.

Bibliography

Bibliography

1. Nicolae, T. and G. Obreja. "Sequential Tests for Two Parameter Weibull Distribution." Proceedings of the 4th Conference on Probability Theory: 329-342. Brasov, Romania: The Center of Mathematical Statistics of the Academy of the Socialist Republic of Romania, September 1971.

2. Callahan, J.C. Sequential Probability Tests for the Weibull Distribution. Unpublished thesis. Wright-Patterson Air Force Base, Ohio: Air Force Institute of Technology, December 1974.

3. Harter, H.L. and A.H. Moore. "An Evaluation of Exponential and Weibull Test Plans." IEEE Transactions on Reliability, R-25, 2:100-104 (June 1976).

4. Williams, J.R. Development of a Standardized Set of Truncated Sequential Probability Ratio Tests for Use With the Weibull Distribution. Unpublished thesis. Wright-Patterson Air Force Base, Ohio: Air Force Institute of Technology, December 1975.

5. Ghosh, B.K. Sequential Tests of Statistical Hypotheses. Reading, Massachusetts: Addison Wesley, 1970.

6. Wald, A. Sequential Analysis. New York: John Wiley and Sons, Inc., 1947.

7. Wetherill, G.B. Sequential Methods in Statistics. London: Methuen and Company Ltd., 1966.

8. Mood, A.M. and F.A. Graybill. Introduction to the Theory of Statistics (Second Edition) New York: McGraw-Hill Book Co. Inc., 1963.

9. Freund, J.E. Mathematical Statistics. Englewood Cliffs, New Jersey: Prentice Hall, Inc., 1962.

10. Neyman, J. and E.S. Pearson. "On the Use and Interpretation of Certain Test Criteria for Purposes of Statistical Inferences." Biometricka, 20A, Part I, 175-240, Part II 263-294 (July/December 1928).

11. Baker, A.G. "Properties of Some Tests in Sequential Analysis." Biometricka, 37:334-346 (December 1950).

12. Wald, A. and J. Wolfowitz. "Optimum Character of the Sequential Probability Ratio Test." Annals of Mathematical Statistics, 19:326-339 (June 1948).

13. Weibull, W. "A Statistical Distribution of Wide Applicability." Journal of Applied Mechanics Transactions of ASME, 18:293-297 (September 1951).

14. Gumbel, E. Statistical Theory of Extreme Values and Some Practical Applications. Washington, D.C. United States Department of Commerce, 1954.

15. Goode, H.P. and J.H.K. Kao. "Sampling Plans Based on the Weibull Distribution." Proceedings of the Seventh National Symposium on Reliability and Quality Control, 24-40. New York: Institute of Radio Engineers, Inc., 1961.

16. Quayle, John R. Estimation of the Scale Parameter of the Weibull Probability Density Function by the Use of One Order Statistic. Masters thesis. Wright-Patterson Air Force Base, Ohio: Air Force Institute of Technology, August 1963.

17. Peto, R. and P. Lee. "Weibull Distributions for Continuous Carcinogenisis Experiments." Biometrics, 29:457-469 (September 1973).

18. Pike, M.C. "A Method of Analysis of a Certain Class of Experiments in Carcinogenisis." Biometrics, 22: 142-161 (March 1966).

19. Kao, J.H.K. "A Summary on Some New Techniques on Failure Analysis." Proceedings of the Sixth National Symposium on Reliability and Quality Control. 190-201. New York: Institute of Radio Engineers, Inc., 1960.

20. Kao, J.H.K. "A New Life-Quality Measure for Electron Tubes." IRE Transactions on Reliability and Quality Control, 7:1-11 (April 1956).

21. Kao, J.H.K. "A Graphical Estimation of Mixed Weibull Parameters in Life Testing Electron Tubes." Technometrics, 1:389-407 (November 1959).

22. Howard, C.B. Evaluation of F-15 Operations and Mainenance Costs Based on Analysis of Category II Test Program Maintenance Data. Masters thesis. Wright-Patterson Air Force Base, Ohio: Air Force Institute of Technology, August 1975. (Can be obtained from NTIS Clearinghouse, Springfield, Va.)

23. Berrettoni, J.N. "Practical Applications of the Weibull Distribution." Industrial Quality Control, 21:71-79 (August 1964).

24. Johnson, N.L. and S. Kotz. Continuous Univariate Distributions -1. Boston: Houghton Mifflin Company, 1970.

25. Gorki, Andrew C. "Beware of the Weibull Euphoria." IEEE Transactions on Reliability, 17, 4:202-203 (December 1968).

26. Epstein, B. and C.K. Tsao. "Some Tests Based on Ordered Observations From Exponential Populations." Annals of Mathematical Statistics, 24:458-466 (September 1953).

27. Epstein, B. and M. Sobel. "Life Testing." American Statistical Association Journal, 48:486-501 (September 1953).

28. Epstein, B. and M. Sobel. "Some Theorems Relevant to Life Testing From an Exponential Distribution." Annals of Mathematical Statistics, 25:373-381 (June 1954).

29. Epstein, B. and M. Sobel. "Truncated Life Tests in the Exponential Case." Annals of Mathematical Statistics, 25:555-564 (September 1954).

30. Epstein B. and M. Sobel. "Sequential Life Tests in the Exponential Case." Annals of Mathematical Statistics, 26:82-93 (March 1955).

31. Epstein, B. "Statistical Life Test Acceptance Procedures." Technometrics, 2, 4:435-447 (November 1960).

32. Stevens, C.F. "A Sequential Test For Comparing Component Reliabilities." IRE Transactions on Reliability and Quality Control, 12:37-47 (November 1957).

33. MIL-STD-781B Reliability Tests: Exponential Distribution, Washington, D.C.: United States Department of Defense, November 1967.

34. Harter, H.L. and A.H. Moore. "Point and Interval Estimators, Based on M Order Statistics, for the Scale Parameter of a Weibull Population with Known Shape Parameter." Technometrics, 7, 3:405-422 (August 1965).

35. Aroian, L.A. "Exact Truncated Tests for the Exponential Density Function." Proceedings of the Ninth National Symposium on Reliability and Quality Control. 470-486. San Francisco, California: Institute of Radio Engineers, Inc., 1963.

36. Goode, H.P. and J.H.K. Kao. Sampling Procedures and Tables for Life and Reliability Testing Based on the Weibull Distribution (Reliable Life Criterion). Quality Control and Reliability Technical Report. TR6. Washington: Office of Assistant Secretary of Defense (Installations and Logistics), February 1963.

37. Zelen, M. and Mary C. Dannemiller. "Are Life Testing Procedures Robust." Proceedings of the Sixth National Symposium on Reliability and Quality Control. 185-189. New York: Institute of Radio Engineers, Inc., 1960.

38. Moog, J.M. "The Optimum Number of Test Units for Military Standard 781-B." Journal of Quality Technology, 6, 1:46-52 (January 1974).

Appendix A

Performance Evaluation Tables for SPRT's with Designated Risks of .05

ACCELERATED TEST W/O REPLACEMENT
INPUT ALPHA= .050 INPUT BETA= .050
MULTIPLICATION FACTOR= 1.50 NMAX= 5000

K	ALPHA	BETA	N(0)	N(1)	T(0)	T(1)
.50	.075	.075	112.20	124.55	5.463	7.592
.52	.079	.070	105.24	116.24	4.925	6.485
.54	.077	.068	97.09	108.78	4.482	5.635
.56	.090	.071	90.72	99.84	4.295	4.974
.58	.089	.060	84.66	93.75	3.782	4.488
.60	.091	.074	79.21	88.30	3.575	4.128
.63	.090	.066	73.18	82.41	3.212	3.681
.65	.081	.073	68.15	77.75	3.005	3.558
.68	.091	.067	63.10	71.33	2.823	2.997
.70	.086	.078	58.61	67.12	2.656	2.819
.73	.084	.067	54.45	63.10	2.410	2.601
.75	.084	.068	51.50	58.51	2.427	2.416
.80	.087	.075	44.53	51.87	2.126	2.157
.85	.086	.066	40.04	46.50	2.048	1.984
.90	.087	.069	35.87	42.51	1.919	1.853
.95	.083	.068	31.87	37.83	1.795	1.668
1.00	.081	.064	28.99	34.75	1.711	1.570
1.10	.083	.058	23.98	29.42	1.619	1.420
1.20	.081	.063	20.71	25.33	1.591	1.327
1.30	.073	.061	17.38	21.80	1.527	1.279
1.40	.077	.064	15.22	19.23	1.495	1.210
1.50	.071	.057	13.43	17.36	1.460	1.170
1.60	.078	.055	11.97	15.31	1.443	1.114
1.70	.073	.053	10.48	13.82	1.437	1.124
1.80	.076	.049	9.48	12.74	1.430	1.116
1.90	.072	.050	8.71	11.74	1.397	1.066
2.00	.068	.046	7.85	10.74	1.410	1.070
2.10	.068	.052	7.27	9.92	1.393	1.044
2.20	.066	.043	6.63	9.34	1.379	1.035
2.30	.073	.041	6.16	8.61	1.370	1.011
2.40	.065	.039	5.70	8.06	1.376	1.014
2.50	.072	.043	5.32	7.52	1.376	1.016
2.80	.066	.035	4.25	6.31	1.358	1.005
3.00	.067	.039	3.89	5.67	1.352	.996
3.30	.070	.031	3.31	4.98	1.326	.981
3.60	.060	.031	2.89	4.43	1.312	.996
3.90	.057	.024	2.68	4.13	1.286	.953
4.30	.050	.023	2.26	3.53	1.268	.948
4.60	.059	.025	2.03	3.12	1.256	.979
5.70	.051	.021	1.60	2.43	1.217	.977

ACCELERATED TEST W/O REPLACEMENT
INPUT ALPHA= .050 INPUT BETA= .050
MULTIPLICATION FACTOR= 2.00 NMAX= 5000

K	ALPHA	BETA	N(0)	N(1)	T(0)	T(1)
.50	.065	.058	122.03	135.04	3.629	4.517
.52	.065	.056	111.65	125.44	2.989	3.653
.54	.068	.061	104.82	113.66	2.955	3.069
.56	.071	.060	98.01	109.01	2.596	3.050
.58	.069	.053	91.16	100.91	2.365	2.720
.60	.061	.051	84.90	95.50	2.211	2.495
.63	.072	.058	78.56	89.13	2.028	2.180
.65	.059	.054	72.95	81.71	1.896	1.985
.68	.063	.052	67.46	76.31	1.761	1.860
.70	.064	.055	63.05	71.51	1.669	1.750
.73	.067	.053	58.63	67.27	1.663	1.653
.75	.059	.055	54.40	62.16	1.523	1.430
.80	.059	.056	48.33	56.44	1.455	1.433
.85	.067	.057	42.35	50.53	1.378	1.272
.90	.063	.047	38.22	45.37	1.328	1.221
.95	.066	.049	34.55	41.20	1.314	1.165
1.00	.066	.050	31.41	37.58	1.262	1.116
1.10	.065	.043	25.97	31.64	1.225	1.026
1.20	.060	.044	21.82	27.29	1.197	.975
1.30	.058	.044	19.00	23.64	1.198	.941
1.40	.062	.046	16.55	20.67	1.202	.918
1.50	.069	.041	14.65	18.51	1.228	.934
1.60	.062	.045	12.69	16.21	1.218	.897
1.70	.059	.038	11.47	14.85	1.223	.894
1.80	.053	.037	10.24	13.54	1.203	.869
1.90	.058	.039	9.18	12.47	1.222	.901
2.00	.059	.041	8.47	11.48	1.243	.899
2.10	.054	.035	7.71	10.66	1.217	.872
2.20	.056	.032	7.12	9.92	1.246	.892
2.30	.049	.031	6.51	9.23	1.232	.874
2.40	.056	.030	6.16	8.54	1.240	.861
2.50	.048	.030	5.62	8.08	1.240	.868
2.80	.053	.026	4.60	6.80	1.263	.889
3.00	.043	.026	4.15	6.14	1.264	.878
3.30	.044	.025	3.49	5.31	1.278	.900
3.60	.043	.016	3.09	4.70	1.272	.893
3.90	.047	.017	2.74	4.24	1.267	.903
4.30	.038	.013	2.32	3.68	1.257	.901
4.60	.034	.013	2.21	3.39	1.243	.879
5.70	.033	.011	1.66	2.60	1.218	.923

ACCELERATED TESTS WITH REPLACEMENT
MONTE CARLO SIZE= 1000
INPUT ALPHA= .050 INPUT BETA= .050
MULTIPLICATION FACTOR= 2.00 NSTAND= 1

K	ALPHA	BETA	N(0)	N(1)	T(0)	T(1)
.50	.059	.052	120.30	135.25	364.328	271.646
.52	.049	.054	110.15	124.76	311.050	231.819
.54	.064	.061	103.82	119.05	273.679	209.185
.56	.068	.068	93.81	112.51	236.264	188.812
.58	.070	.048	90.14	99.36	213.040	154.629
.60	.061	.044	84.14	96.94	191.481	145.840
.63	.059	.063	77.39	89.95	167.034	129.804
.65	.064	.046	73.89	82.98	150.996	113.080
.68	.058	.049	70.06	75.91	136.976	99.022
.70	.063	.046	63.79	70.29	120.706	88.158
.73	.081	.054	57.90	66.08	105.817	80.652
.75	.066	.058	54.69	63.80	97.664	76.419
.80	.066	.051	47.67	55.39	81.415	62.623
.85	.058	.055	43.06	49.93	70.519	54.402
.90	.071	.055	38.31	45.10	60.473	47.496
.95	.065	.051	34.70	39.98	53.207	40.722
1.00	.063	.063	29.47	37.50	44.795	37.769
1.10	.055	.047	26.63	31.97	38.438	30.888
1.20	.055	.051	22.35	26.92	31.478	25.356
1.30	.047	.049	18.27	23.27	25.807	21.451
1.40	.070	.044	16.17	21.01	22.072	19.211
1.50	.068	.044	14.50	18.61	19.461	16.890
1.60	.061	.044	12.98	16.90	17.374	15.255
1.70	.057	.041	11.63	14.98	15.479	13.450
1.80	.046	.038	10.31	13.98	13.786	12.552
1.90	.046	.033	9.06	12.46	12.170	11.044
2.00	.054	.030	8.45	11.43	11.236	10.117
2.10	.054	.029	7.86	10.81	10.397	9.626
2.20	.059	.028	6.97	9.98	9.246	8.882
2.30	.047	.025	6.43	9.17	8.587	8.116
2.40	.044	.030	6.07	8.39	8.090	7.394
2.50	.053	.025	5.64	7.95	7.508	7.011
2.80	.071	.031	4.85	6.68	6.353	5.934
3.00	.053	.018	4.32	6.25	5.729	5.596
3.30	.039	.025	3.37	5.26	4.605	4.728
3.60	.045	.021	3.04	4.74	4.133	4.269
3.90	.039	.022	2.78	4.15	3.777	3.739
4.30	.031	.012	2.26	3.66	3.123	3.326
4.60	.039	.014	2.28	3.42	3.096	3.143
5.70	.032	.009	1.63	2.59	2.266	2.402

ACCELERATED TESTS WITH REPLACEMENT
MONTE CARLO SIZE = 1000
INPUT ALPHA= .050 INPUT BETA= .050
MULTIPLICATION FACTOR= 2.00 NSTAND= 2

K	ALPHA	BETA	N(0)	N(1)	T(0)	T(1)
.50	.055	.056	119.58	136.27	176.471	135.209
.52	.047	.052	112.18	126.94	154.449	117.085
.54	.063	.065	103.52	117.39	133.116	102.078
.56	.055	.073	96.28	112.42	118.571	93.446
.58	.075	.047	91.20	101.97	105.299	79.179
.60	.065	.044	85.05	96.87	94.442	72.227
.63	.054	.061	76.97	88.96	81.828	63.428
.65	.058	.049	73.92	84.14	74.383	57.079
.68	.074	.051	69.91	76.06	67.006	49.424
.70	.059	.053	64.56	69.68	60.333	43.437
.73	.062	.043	59.17	66.37	53.503	40.243
.75	.051	.059	55.52	63.60	49.098	37.881
.80	.060	.058	48.78	56.14	41.135	31.704
.85	.073	.052	43.20	50.87	34.878	27.727
.90	.062	.047	38.65	45.00	30.356	23.587
.95	.079	.080	33.28	40.63	25.535	21.014
1.00	.058	.051	31.63	36.85	23.705	18.400
1.10	.062	.053	26.29	31.36	19.072	15.182
1.20	.051	.042	21.60	26.77	15.581	12.575
1.30	.061	.044	18.92	23.38	13.307	10.869
1.40	.060	.038	16.18	20.92	11.352	9.609
1.50	.059	.042	14.19	18.47	9.906	8.452
1.60	.048	.043	12.49	16.69	8.774	7.641
1.70	.054	.039	11.28	14.85	7.881	6.733
1.80	.058	.035	10.12	13.86	7.087	6.312
1.90	.050	.032	9.31	12.47	6.577	5.645
2.00	.064	.038	8.52	11.28	6.059	5.125
2.10	.058	.028	7.65	10.02	5.449	4.479
2.20	.062	.034	7.26	9.99	5.150	4.597
2.30	.052	.031	6.56	9.05	4.754	4.128
2.40	.054	.029	5.91	8.70	4.350	4.007
2.50	.043	.023	5.74	8.13	4.239	3.737
2.80	.034	.032	4.57	6.69	3.507	3.117
3.00	.053	.028	4.13	6.24	3.188	2.964
3.30	.031	.025	3.53	5.32	2.819	2.560
3.60	.046	.013	3.15	4.79	2.557	2.335
3.90	.039	.016	2.72	4.24	2.298	2.105
4.30	.045	.023	2.34	3.65	2.050	1.844
4.60	.035	.007	2.14	3.38	1.935	1.731
5.70	.031	.010	1.57	2.62	1.640	1.377

ACCELERATED TESTS WITH REPLACEMENT
MONTE CARLO SIZE = 1000
INPUT ALPHA= .050 INPUT BETA= .050
MULTIPLICATION FACTOR= 2.00 NSTAND= 3

K	ALPHA	BETA	N(0)	N(1)	T(0)	T(1)
.50	.059	.054	119.12	135.00	114.419	88.308
.52	.050	.055	111.78	125.21	100.455	75.921
.54	.061	.062	102.73	117.48	86.696	67.508
.56	.063	.076	94.95	112.47	76.442	61.809
.58	.069	.058	92.21	100.82	69.647	51.800
.60	.069	.045	84.79	95.99	61.832	47.819
.63	.066	.058	76.75	89.21	53.406	41.920
.65	.062	.049	74.72	82.56	49.377	36.981
.68	.061	.059	70.96	75.82	44.891	32.745
.70	.059	.053	65.01	69.99	39.893	28.910
.73	.068	.056	59.47	65.89	35.454	26.984
.75	.047	.050	55.51	53.37	32.490	24.929
.80	.069	.056	47.83	55.24	26.595	20.647
.85	.069	.057	42.78	50.82	22.913	18.449
.90	.074	.053	38.10	45.39	19.842	15.880
.95	.074	.062	33.25	41.10	17.015	14.083
1.00	.064	.043	32.68	37.96	16.194	12.673
1.10	.053	.054	26.05	31.97	12.745	10.388
1.20	.068	.051	21.89	27.40	10.455	8.692
1.30	.072	.042	18.58	23.77	8.830	7.411
1.40	.047	.044	16.31	20.85	7.774	6.467
1.50	.043	.045	13.93	18.48	6.718	5.711
1.60	.054	.041	12.79	16.32	6.107	5.005
1.70	.053	.035	11.20	15.18	5.412	4.585
1.80	.052	.041	10.53	13.40	5.099	4.126
1.90	.063	.032	9.34	11.82	4.554	3.601
2.00	.054	.039	8.18	11.70	4.111	3.650
2.10	.052	.030	7.83	10.82	3.931	3.387
2.20	.051	.036	6.93	9.98	3.568	3.148
2.30	.056	.031	6.95	9.26	3.525	2.924
2.40	.043	.024	6.13	8.58	3.239	2.725
2.50	.038	.024	5.69	8.04	3.048	2.564
2.80	.048	.020	4.51	6.82	2.557	2.233
3.00	.040	.025	4.11	6.25	2.390	2.084
3.30	.046	.020	3.65	5.33	2.179	1.819
3.60	.036	.021	2.97	4.73	1.924	1.655
3.90	.033	.016	2.78	4.21	1.837	1.488
4.30	.049	.011	2.42	3.65	1.678	1.323
4.60	.030	.018	2.17	3.43	1.604	1.275
5.70	.024	.004	1.62	2.61	1.401	1.058

ACCELERATED TESTS WITH REPLACEMENT
MONTE CARLO SIZE = 1000
INPUT ALPHA= .050 INPUT BETA= .050
MULTIPLICATION FACTOR= 2.00 NSTAND= 5

K	ALPHA	BETA	N(0)	N(1)	T(0)	T(1)
.50	.061	.058	118.80	134.39	66.022	51.201
.52	.046	.068	112.00	121.33	58.493	43.012
.54	.061	.069	102.08	115.71	50.019	39.016
.56	.068	.065	93.67	112.83	43.697	36.288
.58	.071	.057	91.36	100.85	40.098	30.453
.60	.064	.052	84.06	96.70	35.698	28.107
.63	.053	.060	77.83	87.99	31.703	24.316
.65	.062	.050	73.55	81.88	28.481	21.616
.68	.078	.050	67.78	76.40	25.216	19.407
.70	.065	.055	64.88	71.20	23.352	17.450
.73	.081	.059	60.32	67.88	21.042	16.322
.75	.051	.058	55.55	64.08	19.147	15.012
.80	.057	.046	48.89	55.75	16.107	12.410
.85	.057	.050	41.88	50.67	13.427	10.896
.90	.082	.073	37.93	45.50	11.703	9.599
.95	.066	.047	34.73	41.57	10.550	8.478
1.00	.058	.049	31.83	38.02	9.551	7.625
1.10	.064	.048	25.75	30.87	7.576	5.984
1.20	.060	.048	21.74	26.96	6.378	5.164
1.30	.058	.050	18.50	24.18	5.440	4.636
1.40	.058	.044	16.50	20.51	4.848	3.874
1.50	.052	.034	14.25	18.52	4.260	3.492
1.60	.064	.034	12.44	15.96	3.769	3.003
1.70	.059	.035	11.23	14.94	3.470	2.852
1.80	.057	.044	9.99	13.69	3.143	2.647
1.90	.055	.036	9.21	12.74	2.945	2.480
2.00	.053	.032	8.35	11.62	2.737	2.284
2.10	.042	.034	7.63	10.70	2.566	2.128
2.20	.059	.040	7.00	10.02	2.405	2.023
2.30	.043	.025	6.44	9.11	2.282	1.846
2.40	.035	.037	6.17	8.65	2.216	1.790
2.50	.052	.031	5.67	8.19	2.095	1.709
2.80	.047	.028	4.62	6.90	1.841	1.486
3.00	.037	.032	4.08	6.00	1.719	1.327
3.30	.054	.024	3.49	5.36	1.573	1.241
3.60	.056	.018	3.13	4.76	1.479	1.150
3.90	.037	.011	2.77	4.27	1.423	1.067
4.30	.037	.021	2.36	3.68	1.341	.986
4.60	.034	.009	2.17	3.44	1.311	.951
5.70	.043	.010	1.66	2.61	1.226	.878

Appendix B

<u>Test Plans for Weibull SPRT's</u>

<u>with Designated Risks of .05</u>

TEST I-1

K,SHAPE = .5000   DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .050   INPUT BETA= .050
E(N) = 137.81146   E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	17.150	0.000	46	66.866	34.775
2	18.255	0.000	47	67.971	35.879
3	19.360	0.000	48	69.076	36.984
4	20.465	0.000	49	70.180	38.089
5	21.570	0.000	50	71.285	39.194
6	22.674	0.000	51	72.390	40.299
7	23.779	0.000	52	73.495	41.403
8	24.884	0.000	53	74.600	42.508
9	25.989	0.000	54	75.704	43.613
10	27.094	0.000	55	76.809	44.718
11	28.198	0.000	56	77.914	45.822
12	29.303	0.000	57	79.019	46.927
13	30.408	0.000	58	80.123	48.032
14	31.513	0.000	59	81.228	49.137
15	32.618	.526	60	82.333	50.242
16	33.722	1.631	61	83.438	51.346
17	34.827	2.736	62	84.543	52.451
18	35.932	3.841	63	85.647	53.556
19	37.037	4.945	64	86.752	54.661
20	38.141	6.050	65	87.857	55.766
21	39.246	7.155	66	88.962	56.870
22	40.351	8.260	67	90.067	57.975
23	41.456	9.364	68	91.171	59.080
24	42.561	10.469	69	92.276	60.185
25	43.665	11.574	70	93.381	61.290
26	44.770	12.679	71	94.486	62.394
27	45.875	13.784	72	95.590	63.499
28	46.980	14.888	73	96.695	64.604
29	48.085	15.993	74	97.800	65.709
30	49.189	17.098	75	98.905	66.813
31	50.294	18.203	76	100.010	67.918
32	51.399	19.308	77	101.114	69.023
33	52.504	20.412	78	102.219	70.128
34	53.609	21.517	79	103.324	71.233
35	54.713	22.622	80	104.429	72.337
36	55.818	23.727	81	105.534	73.442
37	56.923	24.832	82	106.638	74.547
38	58.028	25.936	83	107.743	75.652
39	59.132	27.041	84	108.848	76.757
40	60.237	28.146	85	109.953	77.861
41	61.342	29.251	86	111.058	78.966
42	62.447	30.355	87	112.162	80.071
43	63.552	31.460	88	113.267	81.176
44	64.656	32.565	89	114.372	82.281
45	65.761	33.670	90	115.477	83.385

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
91	116.581	84.490	136	166.297	134.205
92	117.686	85.595	137	167.402	135.310
93	118.791	86.700	138	168.507	136.415
94	119.896	87.804	139	169.611	137.520
95	121.001	88.909	140	170.716	138.625
96	122.105	90.014	141	171.821	139.730
97	123.210	91.119	142	172.926	140.834
98	124.315	92.224	143	174.031	141.939
99	125.420	93.328	144	175.135	143.044
100	126.525	94.433	145	176.240	144.149
101	127.629	95.538	146	177.345	145.254
102	128.734	96.643	147	178.450	146.359
103	129.839	97.748	148	179.554	147.463
104	130.944	98.852	149	180.659	148.568
105	132.049	99.957	150	181.764	149.673
106	133.153	101.062	151	182.869	150.777
107	134.258	102.167	152	183.974	151.882
108	135.363	103.272	153	185.078	152.987
109	136.468	104.376	154	186.183	154.092
110	137.572	105.481	155	187.288	155.197
111	138.677	106.586	156	188.393	156.301
112	139.782	107.691	157	189.498	157.406
113	140.887	108.795	158	190.602	158.511
114	141.992	109.900	159	191.707	159.616
115	143.096	111.005	160	192.812	160.721
116	144.201	112.110	161	193.917	161.825
117	145.306	113.215	162	195.022	162.930
118	146.411	114.319	163	196.126	164.035
119	147.516	115.424	164	197.231	165.140
120	148.620	116.529	165	198.336	166.244
121	149.725	117.634	166	199.441	167.349
122	150.830	118.739	167	200.545	168.454
123	151.935	119.843	168	201.650	169.559
124	153.040	120.948	169	202.755	170.664
125	154.144	122.053	170	203.860	171.768
126	155.249	123.158	171	204.965	172.873
127	156.354	124.263	172	206.069	173.978
128	157.459	125.367	173	207.174	175.083
129	158.563	126.472	174	208.279	176.188
130	159.668	127.577	175	209.384	177.292
131	160.773	128.682	176	210.489	178.397
132	161.878	129.786	177	211.593	179.502
133	162.983	130.891	178	212.698	180.607
134	164.037	131.996	179	213.803	181.712
135	165.192	133.101	180	214.908	182.816

TEST	ACCEPT	REJECT
181	216.012	183.921
182	217.117	185.026
183	218.222	186.131
184	219.327	187.235
185	220.432	188.340
186	221.536	189.445
187	222.641	190.550
188	223.746	191.655
189	224.851	192.759
190	225.956	193.864
191	227.060	194.969
192	228.165	196.074
193	229.270	197.179
194	230.375	198.283
195	231.480	199.388
196	232.584	200.493
197	233.689	201.598
198	234.794	202.703
199	235.899	203.807
200	237.003	204.912
201	238.108	206.017
202	239.213	207.122
203	240.318	208.226
204	241.423	209.331
205	242.527	210.436
206	243.632	211.541
207	244.737	212.646
208	245.842	213.750
209	246.947	214.855
210	248.051	215.960
211	249.156	217.065
212	250.261	218.170
213	251.366	219.274
214	252.471	220.379
215	253.575	221.484
216	254.680	222.589
217	255.785	223.694
218	256.890	224.798
219	257.994	225.903
220	259.099	227.008
221	260.204	228.113
222	261.309	229.217
223	262.414	230.322
224	263.518	231.427
225	264.623	232.532

TEST	ACCEPT	REJECT
226	265.728	233.637
227	266.833	234.741
228	267.938	235.846
229	269.042	236.951
230	270.147	238.056
231	271.252	239.161
232	272.357	240.265
233	273.462	241.370
234	274.566	242.475
235	275.671	243.580
236	276.776	244.685
237	277.881	245.789
238	278.985	246.894
239	280.090	247.999
240	281.195	249.104
241	282.300	250.208
242	283.405	251.313
243	284.509	252.418
244	285.614	253.523
245	286.719	254.628
246	287.824	255.732
247	288.929	256.837
248	290.033	257.942
249	291.138	259.047
250	292.243	260.152
251	293.348	261.256
252	294.453	262.361
253	295.557	263.466
254	296.662	264.571
255	297.767	265.675
256	298.872	266.780
257	299.976	267.885
258	301.081	268.990
259	302.186	270.095
260	303.291	271.199
261	304.396	272.304
262	304.922	273.409
263	304.922	274.514
264	304.922	275.619
265	304.922	276.723
266	304.922	277.828
267	304.922	278.933
268	304.922	280.038
269	304.922	281.143
270	304.922	282.247

TEST	ACCEPT	REJECT
271	304.922	283.352
272	304.922	284.457
273	304.922	285.562
274	304.922	286.666
275	304.922	287.771
276	304.922	288.876

TEST I-2

K,SHAPE = .5200 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .050 INPUT BETA= .050
E(N) = 127.74758 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	16.598	0.000	46	66.509	35.531
2	17.707	0.000	47	67.618	36.640
3	18.816	0.000	48	68.727	37.749
4	19.926	0.000	49	69.836	38.858
5	21.035	0.000	50	70.945	39.967
6	22.144	0.000	51	72.054	41.076
7	23.253	0.000	52	73.163	42.185
8	24.362	0.000	53	74.273	43.294
9	25.471	0.000	54	75.382	44.404
10	26.580	0.000	55	76.491	45.513
11	27.689	0.000	56	77.600	46.622
12	28.799	0.000	57	78.709	47.731
13	29.908	0.000	58	79.818	48.840
14	31.017	.039	59	80.927	49.949
15	32.126	1.148	60	82.036	51.058
16	33.235	2.257	61	83.146	52.167
17	34.344	3.366	62	84.255	53.277
18	35.453	4.475	63	85.364	54.386
19	36.562	5.584	64	86.473	55.495
20	37.672	6.693	65	87.582	56.604
21	38.781	7.803	66	88.691	57.713
22	39.890	8.912	67	89.800	58.822
23	40.999	10.021	68	90.909	59.931
24	42.108	11.130	69	92.019	61.040
25	43.217	12.239	70	93.128	62.150
26	44.326	13.348	71	94.237	63.259
27	45.435	14.457	72	95.346	64.368
28	46.545	15.566	73	96.455	65.477
29	47.654	16.675	74	97.564	66.586
30	48.763	17.785	75	98.673	67.695
31	49.872	18.894	76	99.782	68.804
32	50.981	20.003	77	100.892	69.913
33	52.090	21.112	78	102.001	71.023
34	53.199	22.221	79	103.110	72.132
35	54.308	23.330	80	104.219	73.241
36	55.417	24.439	81	105.328	74.350
37	56.527	25.548	82	106.437	75.459
38	57.636	26.658	83	107.546	76.568
39	58.745	27.767	84	108.655	77.677
40	59.854	28.876	85	109.764	78.786
41	60.963	29.985	86	110.874	79.895
42	62.072	31.094	87	111.983	81.005
43	63.181	32.203	88	113.092	82.114
44	64.290	33.312	89	114.201	83.223
45	65.400	34.421	90	115.310	84.332

TEST	ACCEPT	REJECT
91	116.419	85.441
92	117.528	86.550
93	118.637	87.659
94	119.747	88.768
95	120.856	89.878
96	121.965	90.987
97	123.074	92.096
98	124.183	93.205
99	125.292	94.314
100	126.401	95.423
101	127.510	96.532
102	128.620	97.641
103	129.729	98.751
104	130.838	99.860
105	131.947	100.969
106	133.056	102.078
107	134.165	103.187
108	135.274	104.296
109	136.383	105.405
110	137.493	106.514
111	138.602	107.624
112	139.711	108.733
113	140.820	109.842
114	141.929	110.951
115	143.038	112.060
116	144.147	113.169
117	145.256	114.278
118	146.366	115.387
119	147.475	116.497
120	148.584	117.606
121	149.693	118.715
122	150.802	119.824
123	151.911	120.933
124	153.020	122.042
125	154.129	123.151
126	155.239	124.260
127	156.348	125.370
128	157.457	126.479
129	158.566	127.588
130	159.675	128.697
131	160.784	129.806
132	161.893	130.915
133	163.002	132.024
134	164.112	133.133
135	165.221	134.242
136	166.330	135.352
137	167.439	136.461
138	168.548	137.570
139	169.657	138.679
140	170.766	139.788
141	171.875	140.897
142	172.984	142.006
143	174.094	143.115
144	175.203	144.225
145	176.312	145.334
146	177.421	146.443
147	178.530	147.552
148	179.639	148.661
149	180.748	149.770
150	181.857	150.879
151	182.967	151.988
152	184.076	153.098
153	185.185	154.207
154	186.294	155.316
155	187.403	156.425
156	188.512	157.534
157	189.621	158.643
158	190.730	159.752
159	191.840	160.861
160	192.949	161.971
161	194.058	163.080
162	195.167	164.189
163	196.276	165.298
164	197.385	166.407
165	198.494	167.516
166	199.603	168.625
167	200.713	169.734
168	201.822	170.844
169	202.931	171.953
170	204.040	173.062
171	205.149	174.171
172	206.258	175.280
173	207.367	176.389
174	208.476	177.498
175	209.586	178.607
176	210.695	179.717
177	211.804	180.826
178	212.913	181.935
179	214.022	183.044
180	215.131	184.153

TEST	ACCEPT	REJECT
181	216.240	185.262
182	217.349	185.371
183	218.459	187.480
184	219.568	188.590
185	220.677	189.699
186	221.786	190.808
187	222.895	191.917
188	224.004	193.026
189	225.113	194.135
190	225.222	195.244
191	227.332	195.353
192	228.441	197.462
193	229.550	198.572
194	230.659	199.681
195	231.768	200.790
196	232.877	201.899
197	233.986	203.008
198	235.095	204.117
199	236.204	205.226
200	237.314	205.335
201	238.423	207.445
202	239.532	208.554
203	240.641	209.653
204	241.750	210.772
205	242.859	211.881
206	243.968	212.990
207	245.077	214.099
208	246.187	215.208
209	247.296	216.318
210	248.405	217.427
211	249.514	218.536
212	250.623	219.645
213	251.732	220.754
214	252.841	221.863
215	253.950	222.972
216	255.060	224.081
217	256.169	225.191
218	257.278	225.300
219	258.387	227.409
220	259.496	228.518
221	260.605	229.627
222	261.714	230.736
223	262.823	231.845
224	263.933	232.954
225	265.042	234.064

TEST	ACCEPT	REJECT
226	266.151	235.173
227	267.260	236.282
228	268.369	237.391
229	269.478	238.500
230	270.587	239.609
231	271.696	240.718
232	272.806	241.827
233	273.915	242.937
234	275.024	244.046
235	276.133	245.155
236	277.242	246.264
237	278.351	247.373
238	279.460	248.482
239	280.569	249.591
240	281.679	250.700
241	282.788	251.810
242	283.897	252.919
243	283.935	254.028
244	283.935	255.137
245	283.935	256.246
246	283.935	257.355
247	283.935	258.464
248	283.935	259.573
249	283.935	260.682
250	283.935	261.792
251	283.935	262.901
252	283.935	264.010
253	283.935	265.119
254	283.935	265.228
255	283.935	267.337
256	283.935	268.446

TEST I-3

K,SHAPE = .5400 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .050 INPUT BETA= .050
E(N) = 118.76935 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	16.087	0.000	46	66.193	36.246
2	17.201	0.000	47	67.307	37.359
3	18.314	0.000	48	68.420	38.473
4	19.428	0.000	49	69.534	39.586
5	20.541	0.000	50	70.647	40.700
6	21.655	0.000	51	71.761	41.813
7	22.768	0.000	52	72.874	42.926
8	23.882	0.000	53	73.988	44.040
9	24.995	0.000	54	75.101	45.153
10	26.109	0.000	55	76.215	46.267
11	27.222	0.000	56	77.328	47.380
12	28.335	0.000	57	78.441	48.494
13	29.449	0.000	58	79.555	49.607
14	30.562	.615	59	80.668	50.721
15	31.676	1.728	60	81.782	51.834
16	32.789	2.842	61	82.895	52.948
17	33.903	3.955	62	84.009	54.061
18	35.016	5.069	63	85.122	55.175
19	36.130	6.182	64	86.236	56.289
20	37.243	7.296	65	87.349	57.402
21	38.357	8.409	66	88.463	58.515
22	39.470	9.522	67	89.576	59.628
23	40.584	10.636	68	90.690	60.742
24	41.697	11.749	69	91.803	61.855
25	42.811	12.863	70	92.917	62.969
26	43.924	13.976	71	94.030	64.082
27	45.037	15.090	72	95.143	65.196
28	46.151	16.203	73	96.257	66.309
29	47.264	17.317	74	97.370	67.423
30	48.378	18.430	75	98.484	68.536
31	49.491	19.544	76	99.597	69.650
32	50.605	20.657	77	100.711	70.763
33	51.718	21.771	78	101.824	71.877
34	52.832	22.884	79	102.938	72.990
35	53.945	23.998	80	104.051	74.104
36	55.059	25.111	81	105.165	75.217
37	56.172	26.224	82	106.278	76.330
38	57.286	27.338	83	107.392	77.444
39	58.399	28.451	84	108.505	78.557
40	59.513	29.565	85	109.619	79.671
41	60.626	30.678	86	110.732	80.784
42	61.739	31.792	87	111.845	81.898
43	62.853	32.905	88	112.959	83.011
44	63.966	34.019	89	114.072	84.125
45	65.080	35.132	90	115.186	85.238

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
91	116.299	86.352	136	166.405	136.459
92	117.413	87.465	137	167.519	137.571
93	118.526	88.579	138	168.632	138.685
94	119.640	89.692	139	169.746	139.798
95	120.753	90.806	140	170.859	140.912
96	121.867	91.919	141	171.973	142.025
97	122.980	93.033	142	173.086	143.139
98	124.094	94.146	143	174.200	144.252
99	125.207	95.259	144	175.313	145.365
100	126.321	96.373	145	176.427	146.479
101	127.434	97.486	146	177.540	147.592
102	128.547	98.600	147	178.654	148.706
103	129.661	99.713	148	179.767	149.819
104	130.774	100.827	149	180.880	150.933
105	131.888	101.940	150	181.994	152.046
106	133.001	103.054	151	183.107	153.160
107	134.115	104.167	152	184.221	154.273
108	135.228	105.281	153	185.334	155.387
109	136.342	106.394	154	186.448	156.500
110	137.455	107.508	155	187.561	157.614
111	138.569	108.621	156	188.675	158.727
112	139.682	109.735	157	189.788	159.841
113	140.796	110.848	158	190.902	160.954
114	141.909	111.961	159	192.015	162.067
115	143.023	113.075	160	193.129	163.181
116	144.136	114.188	161	194.242	164.294
117	145.250	115.302	162	195.356	165.408
118	146.363	116.415	163	196.469	166.521
119	147.476	117.529	164	197.582	167.635
120	148.590	118.642	165	198.696	168.748
121	149.703	119.756	166	199.809	169.862
122	150.817	120.869	167	200.923	170.975
123	151.930	121.983	168	202.036	172.089
124	153.044	123.096	169	203.150	173.202
125	154.157	124.210	170	204.263	174.316
126	155.271	125.323	171	205.377	175.429
127	156.384	126.437	172	206.490	176.543
128	157.498	127.550	173	207.604	177.656
129	158.611	128.663	174	208.717	178.769
130	159.725	129.777	175	209.831	179.883
131	160.838	130.890	176	210.944	180.996
132	161.952	132.004	177	212.058	182.110
133	163.065	133.117	178	213.171	183.223
134	164.178	134.231	179	214.284	184.337
135	165.292	135.344	180	215.398	185.450

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
181	216.511	186.564	226	265.005	236.670
182	217.625	187.677	227	265.005	237.783
183	218.738	188.791	228	265.005	238.897
184	219.852	189.904	229	265.005	240.010
185	220.965	191.018	230	265.005	241.124
186	222.079	192.131	231	265.005	242.237
187	223.192	193.245	232	265.005	243.351
188	224.306	194.358	233	265.005	244.464
189	225.419	195.472	234	265.005	245.578
190	226.533	196.585	235	265.005	246.691
191	227.646	197.698	236	265.005	247.804
192	228.760	198.812	237	265.005	248.918
193	229.873	199.925	238	265.005	250.031
194	230.986	201.039			
195	232.100	202.152			
196	233.213	203.266			
197	234.327	204.379			
198	235.440	205.493			
199	236.554	206.606			
200	237.667	207.720			
201	238.781	208.833			
202	239.894	209.947			
203	241.008	211.060			
204	242.121	212.174			
205	243.235	213.287			
206	244.348	214.400			
207	245.462	215.514			
208	246.575	216.627			
209	247.689	217.741			
210	248.802	218.854			
211	249.915	219.958			
212	251.029	221.081			
213	252.142	222.195			
214	253.256	223.308			
215	254.369	224.422			
216	255.483	225.535			
217	256.596	226.649			
218	257.710	227.762			
219	258.823	228.876			
220	259.937	229.989			
221	261.050	231.102			
222	262.164	232.216			
223	263.277	233.329			
224	264.391	234.443			
225	265.005	235.556			

TEST I-4

K,SHAPE = .5600 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .050 INPUT BETA= .050
E(N) = 110.72528 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	15.613	0.000	46	65.915	36.924
2	16.731	0.000	47	67.033	38.042
3	17.849	0.000	48	68.151	39.160
4	18.967	0.000	49	69.269	40.278
5	20.085	0.000	50	70.387	41.396
6	21.202	0.000	51	71.504	42.513
7	22.320	0.000	52	72.622	43.631
8	23.438	0.000	53	73.740	44.749
9	24.556	0.000	54	74.858	45.867
10	25.674	0.000	55	75.976	46.985
11	26.792	0.000	56	77.094	48.103
12	27.909	0.000	57	78.211	49.220
13	29.027	.036	58	79.329	50.338
14	30.145	1.154	59	80.447	51.456
15	31.263	2.272	60	81.565	52.574
16	32.381	3.390	61	82.683	53.692
17	33.499	4.507	62	83.801	54.809
18	34.616	5.625	63	84.918	55.927
19	35.734	6.743	64	86.036	57.045
20	36.852	7.861	65	87.154	58.163
21	37.970	8.979	66	88.272	59.281
22	39.088	10.097	67	89.390	60.399
23	40.205	11.214	68	90.507	61.516
24	41.323	12.332	69	91.625	62.634
25	42.441	13.450	70	92.743	63.752
26	43.559	14.568	71	93.861	64.870
27	44.677	15.686	72	94.979	65.988
28	45.795	16.804	73	96.097	67.106
29	46.912	17.921	74	97.214	68.223
30	48.030	19.039	75	98.332	69.341
31	49.148	20.157	76	99.450	70.459
32	50.266	21.275	77	100.568	71.577
33	51.384	22.393	78	101.686	72.695
34	52.502	23.510	79	102.804	73.812
35	53.619	24.628	80	103.921	74.930
36	54.737	25.746	81	105.039	76.048
37	55.855	26.864	82	106.157	77.166
38	56.973	27.982	83	107.275	78.284
39	58.091	29.100	84	108.393	79.402
40	59.208	30.217	85	109.510	80.519
41	60.326	31.335	86	110.628	81.637
42	61.444	32.453	87	111.746	82.755
43	62.562	33.571	88	112.864	83.873
44	63.680	34.689	89	113.982	84.991
45	64.798	35.807	90	115.100	86.109

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
91	116.217	87.226	136	166.519	137.528
92	117.335	88.344	137	167.637	138.646
93	118.453	89.462	138	168.755	139.764
94	119.571	90.580	139	169.873	140.882
95	120.689	91.698	140	170.991	142.000
96	121.807	92.815	141	172.109	143.118
97	122.924	93.933	142	173.226	144.235
98	124.042	95.051	143	174.344	145.353
99	125.160	96.169	144	175.462	146.471
100	126.278	97.287	145	176.580	147.589
101	127.396	98.405	146	177.698	148.707
102	128.513	99.522	147	178.815	149.824
103	129.631	100.640	148	179.933	150.942
104	130.749	101.758	149	181.051	152.060
105	131.867	102.876	150	182.169	153.178
106	132.985	103.994	151	183.287	154.296
107	134.103	105.112	152	184.405	155.414
108	135.220	106.229	153	185.522	156.531
109	136.338	107.347	154	186.640	157.649
110	137.456	108.465	155	187.758	158.767
111	138.574	109.583	156	188.876	159.885
112	139.692	110.701	157	189.994	161.003
113	140.810	111.818	158	191.112	162.120
114	141.927	112.936	159	192.229	163.238
115	143.045	114.054	160	193.347	164.356
116	144.163	115.172	161	194.465	165.474
117	145.281	116.290	162	195.583	166.592
118	146.399	117.408	163	196.701	167.710
119	147.516	118.525	164	197.818	168.827
120	148.634	119.643	165	198.936	169.945
121	149.752	120.761	166	200.054	171.063
122	150.870	121.879	167	201.172	172.181
123	151.988	122.997	168	202.290	173.299
124	153.106	124.115	169	203.408	174.417
125	154.223	125.232	170	204.525	175.534
126	155.341	126.350	171	205.643	176.652
127	156.459	127.468	172	206.761	177.770
128	157.577	128.586	173	207.879	178.888
129	158.695	129.704	174	208.997	180.006
130	159.813	130.821	175	210.115	181.123
131	160.930	131.939	176	211.232	182.241
132	162.048	133.057	177	212.350	183.359
133	163.166	134.175	178	213.468	184.477
134	164.284	135.293	179	214.586	185.595
135	165.402	136.411	180	215.704	186.713

TEST	ACCEPT	REJECT
181	216.821	187.830
182	217.939	188.948
183	219.057	190.066
184	220.175	191.184
185	221.293	192.302
186	222.411	193.420
187	223.528	194.537
188	224.646	195.655
189	225.764	196.773
190	226.882	197.891
191	228.000	199.009
192	229.118	200.126
193	230.235	201.244
194	231.353	202.362
195	232.471	203.480
196	233.589	204.598
197	234.707	205.716
198	235.824	206.833
199	236.942	207.951
200	238.060	209.069
201	239.178	210.187
202	240.296	211.305
203	241.414	212.423
204	242.531	213.540
205	243.649	214.658
206	244.767	215.776
207	245.885	216.894
208	247.003	218.012
209	248.121	219.129
210	248.157	220.247
211	248.157	221.365
212	248.157	222.483
213	248.157	223.601
214	248.157	224.719
215	248.157	225.836
216	248.157	226.954
217	248.157	228.072
218	248.157	229.190
219	248.157	230.308
220	248.157	231.426
221	248.157	232.543
222	248.157	233.661

TEST I-5

K,SHAPE = .5800 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .050 INPUT BETA= .050
E(N) = 103.48950 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	15.173	0.000	46	65.671	37.570
2	16.295	0.000	47	66.793	38.693
3	17.417	0.000	48	67.915	39.815
4	18.539	0.000	49	69.038	40.937
5	19.661	0.000	50	70.160	42.059
6	20.783	0.000	51	71.282	43.181
7	21.906	0.000	52	72.404	44.303
8	23.028	0.000	53	73.526	45.426
9	24.150	0.000	54	74.649	46.548
10	25.272	0.000	55	75.771	47.670
11	26.394	0.000	56	76.893	48.792
12	27.517	0.000	57	78.015	49.914
13	28.639	.538	58	79.137	51.037
14	29.761	1.660	59	80.260	52.159
15	30.883	2.782	60	81.382	53.281
16	32.005	3.905	61	82.504	54.403
17	33.128	5.027	62	83.626	55.525
18	34.250	6.149	63	84.748	56.648
19	35.372	7.271	64	85.870	57.770
20	36.494	8.393	65	86.993	58.892
21	37.616	9.516	66	88.115	60.014
22	38.739	10.638	67	89.237	61.136
23	39.861	11.760	68	90.359	62.259
24	40.983	12.882	69	91.481	63.381
25	42.105	14.004	70	92.604	64.503
26	43.227	15.127	71	93.726	65.625
27	44.349	16.249	72	94.848	66.747
28	45.472	17.371	73	95.970	67.869
29	46.594	18.493	74	97.092	68.992
30	47.716	19.615	75	98.215	70.114
31	48.838	20.738	76	99.337	71.236
32	49.960	21.860	77	100.459	72.358
33	51.083	22.982	78	101.581	73.480
34	52.205	24.104	79	102.703	74.603
35	53.327	25.226	80	103.826	75.725
36	54.449	26.348	81	104.948	76.847
37	55.571	27.471	82	106.070	77.969
38	56.694	28.593	83	107.192	79.091
39	57.816	29.715	84	108.314	80.214
40	58.938	30.837	85	109.436	81.336
41	60.060	31.959	86	110.559	82.458
42	61.182	33.082	87	111.681	83.580
43	62.304	34.204	88	112.803	84.702
44	63.427	35.326	89	113.925	85.825
45	64.549	36.448	90	115.047	86.947

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
91	116.170	88.069	136	166.668	138.567
92	117.292	89.191	137	167.790	139.690
93	118.414	90.313	138	168.912	140.812
94	119.536	91.435	139	170.035	141.934
95	120.658	92.558	140	171.157	143.056
96	121.781	93.680	141	172.279	144.178
97	122.903	94.802	142	173.401	145.301
98	124.025	95.924	143	174.523	146.423
99	125.147	97.046	144	175.646	147.545
100	126.269	98.169	145	176.768	148.667
101	127.391	99.291	146	177.890	149.789
102	128.514	100.413	147	179.012	150.911
103	129.636	101.535	148	180.134	152.034
104	130.758	102.657	149	181.257	153.156
105	131.880	103.780	150	182.379	154.278
106	133.002	104.902	151	183.501	155.400
107	134.125	106.024	152	184.623	156.522
108	135.247	107.146	153	185.745	157.645
109	136.369	108.268	154	186.868	158.767
110	137.491	109.390	155	187.990	159.889
111	138.613	110.513	156	189.112	161.011
112	139.735	111.635	157	190.234	162.133
113	140.858	112.757	158	191.356	163.256
114	141.980	113.879	159	192.478	164.378
115	143.102	115.001	160	193.601	165.500
116	144.224	116.124	161	194.723	166.622
117	145.347	117.246	162	195.845	167.744
118	146.469	118.368	163	196.967	168.867
119	147.591	119.490	164	198.089	169.989
120	148.713	120.612	165	199.212	171.111
121	149.835	121.735	166	200.334	172.233
122	150.957	122.857	167	201.456	173.355
123	152.080	123.979	168	202.578	174.477
124	153.202	125.101	169	203.700	175.600
125	154.324	126.223	170	204.823	176.722
126	155.446	127.346	171	205.945	177.844
127	156.568	128.468	172	207.067	178.966
128	157.691	129.590	173	208.189	180.088
129	158.813	130.712	174	209.311	181.211
130	159.935	131.834	175	210.433	182.333
131	161.057	132.956	176	211.556	183.455
132	162.179	134.079	177	212.678	184.577
133	163.302	135.201	178	213.800	185.699
134	164.424	136.323	179	214.922	186.822
135	165.546	137.445	180	216.044	187.944

TEST	ACCEPT	REJECT
181	217.167	189.066
182	218.289	190.188
183	219.411	191.310
184	220.533	192.432
185	221.655	193.555
186	222.778	194.677
187	223.900	195.799
188	225.022	196.921
189	226.144	198.043
190	227.266	199.166
191	228.389	200.288
192	229.511	201.410
193	230.633	202.532
194	231.755	203.654
195	232.293	204.777
196	232.293	205.899
197	232.293	207.021
198	232.293	208.143
199	232.293	209.265
200	232.293	210.388
201	232.293	211.510
202	232.293	212.632
203	232.293	213.754
204	232.293	214.876
205	232.293	215.998
206	232.293	217.121
207	232.293	218.243

TEST I-6

K,SHAPE = .6000   DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .050   INPUT BETA= .050
E(N) = 96.95667   E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	14.762	0.000	46	65.457	38.187
2	15.888	0.000	47	66.584	39.314
3	17.015	0.000	48	67.710	40.440
4	18.141	0.000	49	68.837	41.567
5	19.268	0.000	50	69.963	42.693
6	20.394	0.000	51	71.090	43.820
7	21.521	0.000	52	72.216	44.946
8	22.648	0.000	53	73.343	46.073
9	23.774	0.000	54	74.470	47.200
10	24.901	0.000	55	75.596	48.326
11	26.027	0.000	56	76.723	49.453
12	27.154	0.000	57	77.849	50.579
13	28.280	1.010	58	78.976	51.706
14	29.407	2.137	59	80.102	52.832
15	30.533	3.264	60	81.229	53.959
16	31.660	4.390	61	82.356	55.086
17	32.787	5.517	62	83.482	56.212
18	33.913	6.643	63	84.609	57.339
19	35.040	7.770	64	85.735	58.465
20	36.166	8.896	65	86.862	59.592
21	37.293	10.023	66	87.988	60.718
22	38.419	11.149	67	89.115	61.845
23	39.546	12.276	68	90.242	62.972
24	40.673	13.403	69	91.368	64.098
25	41.799	14.529	70	92.495	65.225
26	42.926	15.656	71	93.621	66.351
27	44.052	16.782	72	94.748	67.478
28	45.179	17.909	73	95.874	68.604
29	46.305	19.035	74	97.001	69.731
30	47.432	20.162	75	98.127	70.858
31	48.559	21.289	76	99.254	71.984
32	49.585	22.415	77	100.381	73.111
33	50.812	23.542	78	101.507	74.237
34	51.938	24.658	79	102.634	75.364
35	53.065	25.795	80	103.760	76.490
36	54.191	25.921	81	104.887	77.517
37	55.318	28.048	82	106.013	78.743
38	56.445	29.175	83	107.140	79.870
39	57.571	30.301	84	108.267	80.997
40	58.698	31.428	85	109.393	82.123
41	59.824	32.554	86	110.520	83.250
42	60.951	33.681	87	111.646	84.376
43	62.077	34.807	88	112.773	85.503
44	63.204	35.934	89	113.899	86.629
45	64.330	37.061	90	115.026	87.756

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
91	116.153	88.883	136	166.848	139.578
92	117.279	90.009	137	167.975	140.705
93	118.406	91.136	138	169.101	141.831
94	119.532	92.262	139	170.228	142.958
95	120.659	93.389	140	171.354	144.084
96	121.785	94.515	141	172.481	145.211
97	122.912	95.642	142	173.607	146.337
98	124.039	96.769	143	174.734	147.464
99	125.165	97.895	144	175.861	148.591
100	126.292	99.022	145	176.987	149.717
101	127.418	100.148	146	178.114	150.844
102	128.545	101.275	147	179.240	151.970
103	129.671	102.401	148	180.367	153.097
104	130.798	103.528	149	181.493	154.223
105	131.924	104.655	150	182.620	155.350
106	133.051	105.781	151	183.747	156.477
107	134.178	106.908	152	184.873	157.603
108	135.304	108.034	153	186.000	158.730
109	136.431	109.161	154	187.126	159.856
110	137.557	110.287	155	188.253	160.983
111	138.684	111.414	156	189.379	162.109
112	139.810	112.540	157	190.506	163.236
113	140.937	113.667	158	191.633	164.363
114	142.064	114.794	159	192.759	165.489
115	143.190	115.920	160	193.886	166.616
116	144.317	117.047	161	195.012	167.742
117	145.443	118.173	162	196.139	168.869
118	146.570	119.300	163	197.265	169.995
119	147.696	120.426	164	198.392	171.122
120	148.823	121.553	165	199.518	172.249
121	149.950	122.680	166	200.645	173.375
122	151.076	123.806	167	201.772	174.502
123	152.203	124.933	168	202.898	175.628
124	153.329	126.059	169	204.025	176.755
125	154.456	127.186	170	205.151	177.881
126	155.582	128.312	171	206.278	179.008
127	156.709	129.439	172	207.404	180.134
128	157.836	130.566	173	208.531	181.261
129	158.962	131.692	174	209.658	182.388
130	160.089	132.819	175	210.784	183.514
131	161.215	133.945	176	211.911	184.641
132	162.342	135.072	177	213.037	185.767
133	163.468	136.198	178	214.164	186.894
134	164.595	137.325	179	215.290	188.020
135	165.721	138.452	180	216.417	189.147

TEST	ACCEPT	REJECT
181	217.544	190.274
182	218.554	191.400
183	218.554	192.527
184	218.554	193.653
185	218.554	194.780
186	218.554	195.906
187	218.554	197.033
188	218.554	198.150
189	218.554	199.286
190	218.554	200.413
191	218.554	201.539
192	218.554	202.666
193	218.554	203.792
194	218.554	204.919

TEST I-7

K,SHAPE = .6250 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .050 INPUT BETA= .050
E(N) = 89.64537 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	14.285	0.000	46	65.228	38.921
2	15.417	0.000	47	66.360	40.053
3	16.550	0.000	48	67.492	41.185
4	17.682	0.000	49	68.624	42.317
5	18.814	0.000	50	69.756	43.449
6	19.946	0.000	51	70.888	44.581
7	21.078	0.000	52	72.020	45.713
8	22.210	0.000	53	73.152	46.846
9	23.342	0.000	54	74.284	47.978
10	24.474	0.000	55	75.416	49.110
11	25.606	0.000	56	76.548	50.242
12	26.738	.431	57	77.680	51.374
13	27.870	1.563	58	78.812	52.506
14	29.002	2.695	59	79.945	53.638
15	30.134	3.827	60	81.077	54.770
16	31.266	4.959	61	82.209	55.902
17	32.398	6.092	62	83.341	57.034
18	33.530	7.224	63	84.473	58.166
19	34.662	8.356	64	85.605	59.298
20	35.794	9.488	65	86.737	60.430
21	36.926	10.620	66	87.869	61.562
22	38.059	11.752	67	89.001	62.694
23	39.191	12.884	68	90.133	63.826
24	40.323	14.016	69	91.265	64.958
25	41.455	15.148	70	92.397	66.090
26	42.587	16.280	71	93.529	67.222
27	43.719	17.412	72	94.661	68.355
28	44.851	18.544	73	95.793	69.487
29	45.983	19.676	74	96.925	70.619
30	47.115	20.808	75	98.057	71.751
31	48.247	21.940	76	99.189	72.883
32	49.379	23.072	77	100.321	74.015
33	50.511	24.204	78	101.454	75.147
34	51.643	25.336	79	102.586	76.279
35	52.775	26.469	80	103.718	77.411
36	53.907	27.601	81	104.850	78.543
37	55.039	28.733	82	105.982	79.675
38	56.171	29.865	83	107.114	80.807
39	57.303	30.997	84	108.246	81.939
40	58.435	32.129	85	109.378	83.071
41	59.568	33.261	86	110.510	84.203
42	60.700	34.393	87	111.642	85.335
43	61.832	35.525	88	112.774	86.467
44	62.964	36.657	89	113.906	87.599
45	64.096	37.789	90	115.038	88.731

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
91	116.170	89.854	136	167.113	140.806
92	117.302	90.996	137	168.245	141.938
93	118.434	92.128	138	169.377	143.070
94	119.566	93.260	139	170.509	144.202
95	120.698	94.392	140	171.641	145.334
96	121.831	95.524	141	172.773	146.466
97	122.963	96.656	142	173.905	147.598
98	124.095	97.788	143	175.037	148.730
99	125.227	98.920	144	176.169	149.862
100	126.359	100.052	145	177.301	150.994
101	127.491	101.184	146	178.433	152.127
102	128.623	102.316	147	179.565	153.259
103	129.755	103.448	148	180.697	154.391
104	130.887	104.580	149	181.829	155.523
105	132.019	105.712	150	182.961	156.655
106	133.151	106.844	151	184.093	157.787
107	134.283	107.976	152	185.226	158.919
108	135.415	109.108	153	186.358	160.051
109	136.547	110.241	154	187.490	161.183
110	137.679	111.373	155	188.622	162.315
111	138.811	112.505	156	189.754	163.447
112	139.943	113.637	157	190.886	164.579
113	141.075	114.769	158	192.018	165.711
114	142.207	115.901	159	193.150	166.843
115	143.340	117.033	160	194.282	167.975
116	144.472	118.165	161	195.414	169.107
117	145.604	119.297	162	196.546	170.239
118	146.736	120.429	163	197.678	171.371
119	147.868	121.561	164	198.810	172.503
120	149.000	122.693	165	199.942	173.635
121	150.132	123.825	166	201.074	174.768
122	151.264	124.957	167	202.206	175.900
123	152.396	126.089	168	203.338	177.032
124	153.528	127.221	169	203.770	178.164
125	154.660	128.353	170	203.770	179.296
126	155.792	129.485	171	203.770	180.428
127	156.924	130.617	172	203.770	181.560
128	158.056	131.750	173	203.770	182.692
129	159.188	132.882	174	203.770	183.824
130	160.320	134.014	175	203.770	184.956
131	161.452	135.146	176	203.770	186.088
132	162.584	136.278	177	203.770	187.220
133	163.716	137.410	178	203.770	188.352
134	164.849	138.542	179	203.770	189.484
135	165.981	139.674	180	203.770	190.616

TEST I-8

K,SHAPE = .6500 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .050 INPUT BETA= .050
E(N) = 83.15081 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	13.846	0.000	46	65.037	39.519
2	14.984	0.000	47	66.174	40.756
3	16.122	0.000	48	67.312	41.894
4	17.259	0.000	49	68.449	43.031
5	18.397	0.000	50	69.587	44.169
6	19.534	0.000	51	70.724	45.307
7	20.672	0.000	52	71.862	46.444
8	21.809	0.000	53	72.999	47.582
9	22.947	0.000	54	74.137	48.719
10	24.085	0.000	55	75.275	49.857
11	25.222	0.000	56	76.412	50.994
12	26.360	.942	57	77.550	52.132
13	27.497	2.079	58	78.687	53.269
14	28.635	3.217	59	79.825	54.407
15	29.772	4.354	60	80.962	55.545
16	30.910	5.492	61	82.100	56.682
17	32.047	6.630	62	83.238	57.820
18	33.185	7.767	63	84.375	58.957
19	34.323	8.905	64	85.513	60.095
20	35.460	10.042	65	86.650	61.232
21	36.598	11.180	66	87.788	62.370
22	37.735	12.317	67	88.925	63.507
23	38.873	13.455	68	90.063	64.645
24	40.010	14.592	69	91.200	65.783
25	41.148	15.730	70	92.338	66.920
26	42.285	16.868	71	93.476	68.058
27	43.423	18.005	72	94.613	69.195
28	44.561	19.143	73	95.751	70.333
29	45.698	20.280	74	96.888	71.470
30	46.836	21.418	75	98.026	72.608
31	47.973	22.555	76	99.163	73.745
32	49.111	23.693	77	100.301	74.883
33	50.248	24.830	78	101.438	76.021
34	51.386	25.968	79	102.576	77.158
35	52.523	27.106	80	103.714	78.296
36	53.661	28.243	81	104.851	79.433
37	54.799	29.381	82	105.989	80.571
38	55.936	30.518	83	107.126	81.708
39	57.074	31.656	84	108.264	82.846
40	58.211	32.793	85	109.401	83.983
41	59.349	33.931	86	110.539	85.121
42	60.486	35.068	87	111.676	86.259
43	61.624	36.206	88	112.814	87.396
44	62.761	37.344	89	113.952	88.534
45	63.899	38.481	90	115.089	89.671

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
91	116.227	90.809	136	167.417	141.999
92	117.364	91.946	137	168.554	143.136
93	118.502	93.084	138	169.692	144.274
94	119.639	94.221	139	170.829	145.412
95	120.777	95.359	140	171.967	146.549
96	121.914	96.497	141	173.105	147.687
97	123.052	97.634	142	174.242	148.824
98	124.190	98.772	143	175.380	149.962
99	125.327	99.909	144	176.517	151.099
100	126.465	101.047	145	177.655	152.237
101	127.602	102.184	146	178.792	153.375
102	128.740	103.322	147	179.930	154.512
103	129.877	104.460	148	181.067	155.650
104	131.015	105.597	149	182.205	156.787
105	132.153	106.735	150	183.343	157.925
106	133.290	107.872	151	184.480	159.062
107	134.428	109.010	152	185.618	160.200
108	135.565	110.147	153	186.755	161.337
109	136.703	111.285	154	187.893	162.475
110	137.840	112.422	155	189.030	163.613
111	138.978	113.560	156	189.972	164.750
112	140.115	114.698	157	189.972	165.888
113	141.253	115.835	158	189.972	167.025
114	142.391	116.973	159	189.972	168.163
115	143.528	118.110	160	189.972	169.300
116	144.666	119.248	161	189.972	170.438
117	145.803	120.385	162	189.972	171.575
118	146.941	121.523	163	189.972	172.713
119	148.078	122.660	164	189.972	173.851
120	149.216	123.798	165	189.972	174.988
121	150.353	124.936	166	189.972	176.126
122	151.491	126.073	167	189.972	177.263
123	152.629	127.211			
124	153.766	128.348			
125	154.904	129.486			
126	156.041	130.623			
127	157.179	131.761			
128	158.316	132.898			
129	159.454	134.036			
130	160.591	135.174			
131	161.729	136.311			
132	162.867	137.449			
133	164.004	138.586			
134	165.142	139.724			
135	166.279	140.861			

TEST I-9

K,SHAPE = .6750 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .050 INPUT BETA= .050
E(N) = 77.35504 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	13.441	0.000	46	64.879	40.284
2	14.584	0.000	47	66.022	41.427
3	15.727	0.000	48	67.165	42.570
4	16.870	0.000	49	68.308	43.713
5	18.013	0.000	50	69.452	44.856
6	19.156	0.000	51	70.595	45.999
7	20.299	0.000	52	71.738	47.142
8	21.442	0.000	53	72.881	48.286
9	22.585	0.000	54	74.024	49.429
10	23.728	0.000	55	75.167	50.572
11	24.871	.276	56	76.310	51.715
12	26.015	1.419	57	77.453	52.858
13	27.158	2.562	58	78.596	54.001
14	28.301	3.705	59	79.739	55.144
15	29.444	4.849	60	80.882	56.287
16	30.587	5.992	61	82.025	57.430
17	31.730	7.135	62	83.169	58.573
18	32.873	8.278	63	84.312	59.716
19	34.016	9.421	64	85.455	60.859
20	35.159	10.564	65	86.598	62.002
21	36.302	11.707	66	87.741	63.145
22	37.445	12.850	67	88.884	64.289
23	38.588	13.993	68	90.027	65.432
24	39.732	15.136	69	91.170	66.575
25	40.875	16.279	70	92.313	67.718
26	42.018	17.422	71	93.456	68.861
27	43.161	18.565	72	94.599	70.004
28	44.304	19.709	73	95.742	71.147
29	45.447	20.852	74	96.885	72.290
30	46.590	21.995	75	98.029	73.433
31	47.733	23.138	76	99.172	74.576
32	48.876	24.281	77	100.315	75.719
33	50.019	25.424	78	101.458	76.863
34	51.162	26.567	79	102.601	78.006
35	52.305	27.710	80	103.744	79.149
36	53.448	28.853	81	104.887	80.292
37	54.592	29.996	82	106.030	81.435
38	55.735	31.139	83	107.173	82.578
39	56.878	32.282	84	108.316	83.721
40	58.021	33.426	85	109.459	84.864
41	59.164	34.569	86	110.602	86.007
42	60.307	35.712	87	111.745	87.150
43	61.450	36.855	88	112.889	88.293
44	62.593	37.998	89	114.032	89.436
45	63.736	39.141	90	115.175	90.579

TEST	ACCEPT	REJECT
91	116.318	91.723
92	117.461	92.866
93	118.604	94.009
94	119.747	95.152
95	120.890	96.295
96	122.033	97.438
97	123.176	98.581
98	124.319	99.724
99	125.462	100.867
100	126.606	102.010
101	127.749	103.153
102	128.892	104.296
103	130.035	105.439
104	131.178	106.583
105	132.321	107.726
106	133.464	108.869
107	134.607	110.012
108	135.750	111.155
109	136.893	112.298
110	138.036	113.441
111	139.179	114.584
112	140.322	115.727
113	141.465	116.870
114	142.609	118.013
115	143.752	119.156
116	144.895	120.300
117	146.038	121.443
118	147.181	122.586
119	148.324	123.729
120	149.467	124.872
121	150.610	126.015
122	151.753	127.158
123	152.896	128.301
124	154.039	129.444
125	155.182	130.587
126	156.326	131.730
127	157.469	132.873
128	158.612	134.016
129	159.755	135.160
130	160.898	136.303
131	162.041	137.446
132	163.184	138.589
133	164.327	139.732
134	165.470	140.875
135	166.613	142.018
136	167.756	143.161
137	168.899	144.304
138	170.043	145.447
139	171.186	146.590
140	172.329	147.733
141	173.472	148.876
142	174.615	150.020
143	175.758	151.163
144	176.901	152.306
145	177.177	153.449
146	177.177	154.592
147	177.177	155.735
148	177.177	156.878
149	177.177	158.021
150	177.177	159.164
151	177.177	160.307
152	177.177	161.450
153	177.177	162.593
154	177.177	163.737
155	177.177	164.880

TEST I-10

K,SHAPE = .7000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .050 INPUT BETA= .050
E(N) = 72.16068 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	13.064	0.000	46	64.752	40.920
2	14.213	0.000	47	65.901	42.069
3	15.362	0.000	48	67.049	43.218
4	16.510	0.000	49	68.198	44.366
5	17.659	0.000	50	69.347	45.515
6	18.808	0.000	51	70.495	46.664
7	19.956	0.000	52	71.644	47.812
8	21.105	0.000	53	72.793	48.961
9	22.253	0.000	54	73.941	50.109
10	23.402	0.000	55	75.090	51.258
11	24.551	.719	56	76.238	52.407
12	25.699	1.868	57	77.387	53.555
13	26.848	3.016	58	78.536	54.704
14	27.997	4.165	59	79.684	55.853
15	29.145	5.313	60	80.833	57.001
16	30.294	6.462	61	81.982	58.150
17	31.442	7.611	62	83.130	59.298
18	32.591	8.759	63	84.279	60.447
19	33.740	9.908	64	85.427	61.596
20	34.888	11.056	65	86.576	62.744
21	36.037	12.205	66	87.725	63.893
22	37.185	13.354	67	88.873	65.041
23	38.334	14.502	68	90.022	66.190
24	39.483	15.651	69	91.170	67.339
25	40.631	16.800	70	92.319	68.487
26	41.780	17.948	71	93.468	69.636
27	42.929	19.097	72	94.616	70.785
28	44.077	20.245	73	95.765	71.933
29	45.226	21.394	74	96.914	73.082
30	46.374	22.543	75	98.062	74.230
31	47.523	23.691	76	99.211	75.379
32	48.672	24.840	77	100.359	76.528
33	49.820	25.988	78	101.508	77.676
34	50.969	27.137	79	102.657	78.825
35	52.117	28.286	80	103.805	79.973
36	53.266	29.434	81	104.954	81.122
37	54.415	30.583	82	106.102	82.271
38	55.563	31.732	83	107.251	83.419
39	56.712	32.880	84	108.400	84.568
40	57.861	34.029	85	109.548	85.717
41	59.009	35.177	86	110.697	86.865
42	60.158	36.326	87	111.846	88.014
43	61.306	37.475	88	112.994	89.162
44	62.455	38.623	89	114.143	90.311
45	63.604	39.772	90	115.291	91.460

TEST	ACCEPT	REJECT
91	116.440	92.608
92	117.589	93.757
93	118.737	94.905
94	119.886	96.054
95	121.034	97.203
96	122.183	98.351
97	123.332	99.500
98	124.480	100.649
99	125.629	101.797
100	126.778	102.946
101	127.926	104.094
102	129.075	105.243
103	130.223	106.392
104	131.372	107.540
105	132.521	108.689
106	133.669	109.838
107	134.818	110.986
108	135.967	112.135
109	137.115	113.283
110	138.264	114.432
111	139.412	115.581
112	140.561	116.729
113	141.710	117.878
114	142.858	119.026
115	144.007	120.175
116	145.155	121.324
117	146.304	122.472
118	147.453	123.621
119	148.601	124.770
120	149.750	125.918
121	150.899	127.067
122	152.047	128.215
123	153.196	129.364
124	154.344	130.513
125	155.493	131.661
126	156.642	132.810
127	157.790	133.958
128	158.939	135.107
129	160.087	136.256
130	161.236	137.404
131	162.385	138.553
132	163.533	139.702
133	164.682	140.850
134	165.831	141.999
135	166.549	143.147

TEST	ACCEPT	REJECT
136	166.549	144.296
137	166.549	145.445
138	166.549	146.593
139	166.549	147.742
140	166.549	148.890
141	166.549	150.039
142	166.549	151.188
143	166.549	152.336
144	166.549	153.485
145	166.549	154.534

TEST I-11

K,SHAPE = .7250 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .050 INPUT BETA= .050
E(N) = 67.48580 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	12.715	0.000	46	64.653	41.531
2	13.869	0.000	47	65.807	42.685
3	15.023	0.000	48	66.961	43.840
4	16.177	0.000	49	68.115	44.994
5	17.331	0.000	50	69.269	46.148
6	18.486	0.000	51	70.423	47.302
7	19.640	0.000	52	71.578	48.456
8	20.794	0.000	53	72.732	49.610
9	21.948	0.000	54	73.886	50.765
10	23.102	0.000	55	75.040	51.919
11	24.257	1.135	56	76.194	53.073
12	25.411	2.289	57	77.348	54.227
13	26.565	3.444	58	78.503	55.381
14	27.719	4.598	59	79.657	56.535
15	28.873	5.752	60	80.811	57.690
16	30.027	6.906	61	81.965	58.844
17	31.182	8.060	62	83.119	59.998
18	32.336	9.214	63	84.273	61.152
19	33.490	10.369	64	85.428	62.306
20	34.644	11.523	65	86.582	63.461
21	35.798	12.677	66	87.736	64.615
22	36.952	13.831	67	88.890	65.769
23	38.107	14.985	68	90.044	66.923
24	39.261	16.139	69	91.198	68.077
25	40.415	17.294	70	92.353	69.231
26	41.569	18.448	71	93.507	70.386
27	42.723	19.602	72	94.661	71.540
28	43.877	20.756	73	95.815	72.694
29	45.032	21.910	74	96.969	73.848
30	46.186	23.065	75	98.124	75.002
31	47.340	24.219	76	99.278	76.156
32	48.494	25.373	77	100.432	77.311
33	49.648	26.527	78	101.586	78.465
34	50.802	27.681	79	102.740	79.619
35	51.957	28.835	80	103.894	80.773
36	53.111	29.990	81	105.049	81.927
37	54.265	31.144	82	106.203	83.081
38	55.419	32.298	83	107.357	84.236
39	56.573	33.452	84	108.511	85.390
40	57.728	34.606	85	109.665	86.544
41	58.882	35.760	86	110.819	87.698
42	60.036	36.915	87	111.974	88.852
43	61.190	38.069	88	113.128	90.006
44	62.344	39.223	89	114.282	91.161
45	63.498	40.377	90	115.436	92.315

TEST	ACCEPT	REJECT
91	116.590	93.469
92	117.744	94.623
93	118.899	95.777
94	120.053	96.932
95	121.207	98.086
96	122.361	99.240
97	123.515	100.394
98	124.669	101.548
99	125.824	102.702
100	126.978	103.857
101	128.132	105.011
102	129.286	106.165
103	130.440	107.319
104	131.595	108.473
105	132.749	109.627
106	133.903	110.782
107	135.057	111.936
108	136.211	113.090
109	137.365	114.244
110	138.520	115.398
111	139.674	116.552
112	140.828	117.707
113	141.982	118.851
114	143.136	120.015
115	144.290	121.169
116	145.445	122.323
117	146.599	123.477
118	147.753	124.632
119	148.907	125.786
120	150.061	125.940
121	151.215	128.094
122	152.370	129.248
123	153.524	130.403
124	154.678	131.557
125	155.813	132.711
126	155.813	133.865
127	155.813	135.019
128	155.813	136.173
129	155.813	137.328
130	155.813	138.482
131	155.813	139.636
132	155.813	140.790
133	155.813	141.944
134	155.813	143.098
135	155.813	144.253

TEST I-12

K,SHAPE = .7500 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .050 INPUT BETA= .050
E(N) = 63.26567 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	12.389	0.000
2	13.549	0.000
3	14.708	0.000
4	15.868	0.000
5	17.028	0.000
6	18.188	0.000
7	19.347	0.000
8	20.507	0.000
9	21.667	0.000
10	22.827	.368
11	23.986	1.528
12	25.146	2.688
13	26.306	3.847
14	27.466	5.007
15	28.625	6.167
16	29.785	7.327
17	30.945	8.486
18	32.105	9.646
19	33.264	10.806
20	34.424	11.966
21	35.584	13.125
22	36.744	14.285
23	37.903	15.445
24	39.063	16.605
25	40.223	17.764
26	41.383	18.924
27	42.542	20.084
28	43.702	21.244
29	44.862	22.403
30	46.022	23.563
31	47.181	24.723
32	48.341	25.883
33	49.501	27.042
34	50.661	28.202
35	51.820	29.362
36	52.980	30.522
37	54.140	31.681
38	55.299	32.841
39	56.459	34.001
40	57.619	35.161
41	58.779	36.320
42	59.938	37.480
43	61.098	38.640
44	62.258	39.800
45	63.418	40.959
46	64.577	42.119
47	65.737	43.279
48	66.897	44.438
49	68.057	45.598
50	69.216	46.758
51	70.376	47.918
52	71.536	49.077
53	72.696	50.237
54	73.855	51.397
55	75.015	52.557
56	76.175	53.716
57	77.335	54.876
58	78.494	56.036
59	79.654	57.196
60	80.814	58.355
61	81.974	59.515
62	83.133	60.675
63	84.293	61.835
64	85.453	62.994
65	86.613	64.154
66	87.772	65.314
67	88.932	66.474
68	90.092	67.633
69	91.252	68.793
70	92.411	69.953
71	93.571	71.113
72	94.731	72.272
73	95.891	73.432
74	97.050	74.592
75	98.210	75.752
76	99.370	76.911
77	100.530	78.071
78	101.689	79.231
79	102.849	80.391
80	104.009	81.550
81	105.168	82.710
82	106.328	83.870
83	107.488	85.030
84	108.648	86.189
85	109.807	87.349
86	110.967	88.509
87	112.127	89.668
88	113.287	90.828
89	114.446	91.988
90	115.606	93.148

TEST	ACCEPT	REJECT
91	116.765	94.307
92	117.926	95.467
93	119.085	96.627
94	120.245	97.787
95	121.405	98.946
96	122.565	100.106
97	123.724	101.266
98	124.884	102.426
99	126.044	103.585
100	127.204	104.745
101	128.363	105.905
102	129.523	107.065
103	130.683	108.224
104	131.843	109.384
105	133.002	110.544
106	134.162	111.704
107	135.322	112.863
108	136.482	114.023
109	137.641	115.183
110	138.801	115.343
111	139.961	117.502
112	141.121	118.662
113	142.280	119.822
114	143.440	120.982
115	144.600	122.141
116	145.760	123.301
117	146.919	124.461
118	147.287	125.621
119	147.287	125.780
120	147.287	127.940
121	147.287	129.100
122	147.287	130.260
123	147.287	131.419
124	147.287	132.579
125	147.287	133.739
126	147.287	134.899
127	147.287	136.058

TEST I-13

K,SHAPE = .8000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .050 INPUT BETA= .050
E(N) = 55.96224 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	11.800	0.000	46	64.492	43.234
2	12.971	0.000	47	65.663	44.405
3	14.142	0.000	48	66.834	45.576
4	15.313	0.000	49	68.005	46.747
5	16.484	0.000	50	69.176	47.918
6	17.655	0.000	51	70.347	49.089
7	18.826	0.000	52	71.518	50.260
8	19.997	0.000	53	72.689	51.431
9	21.167	0.000	54	73.860	52.602
10	22.338	1.080	55	75.031	53.773
11	23.509	2.251	56	76.202	54.944
12	24.680	3.422	57	77.373	56.114
13	25.851	4.593	58	78.543	57.285
14	27.022	5.764	59	79.714	58.456
15	28.193	6.935	60	80.885	59.627
16	29.364	8.106	61	82.056	60.798
17	30.535	9.277	62	83.227	61.969
18	31.706	10.448	63	84.398	63.140
19	32.877	11.619	64	85.569	64.311
20	34.048	12.790	65	86.740	65.482
21	35.219	13.961	66	87.911	66.653
22	36.390	15.132	67	89.082	67.824
23	37.561	16.303	68	90.253	68.995
24	38.732	17.474	69	91.424	70.166
25	39.902	18.644	70	92.595	71.337
26	41.073	19.815	71	93.766	72.508
27	42.244	20.986	72	94.937	73.679
28	43.415	22.157	73	96.108	74.850
29	44.586	23.328	74	97.278	76.020
30	45.757	24.499	75	98.449	77.191
31	46.928	25.670	76	99.620	78.362
32	48.099	26.841	77	100.791	79.533
33	49.270	28.012	78	101.962	80.704
34	50.441	29.183	79	103.133	81.875
35	51.612	30.354	80	104.304	83.045
36	52.783	31.525	81	105.475	84.217
37	53.954	32.696	82	106.646	85.388
38	55.125	33.867	83	107.817	86.559
39	56.296	35.038	84	108.988	87.730
40	57.467	36.209	85	110.159	88.901
41	58.638	37.379	86	111.330	90.072
42	59.808	38.550	87	112.501	91.243
43	60.979	39.721	88	113.672	92.414
44	62.150	40.892	89	114.843	93.585
45	63.321	42.063	90	116.014	94.755

TEST	ACCEPT	REJECT
91	117.184	95.926
92	118.355	97.097
93	119.526	98.258
94	120.697	99.439
95	121.868	100.610
96	123.039	101.781
97	124.210	102.952
98	125.381	104.123
99	126.552	105.294
100	127.723	106.455
101	128.894	107.636
102	130.065	108.807
103	131.145	109.978
104	131.145	111.149
105	131.145	112.320
106	131.145	113.490
107	131.145	114.661
108	131.145	115.832
109	131.145	117.003
110	131.145	118.174
111	131.145	119.345
112	131.145	120.516

TEST I-14

K,SHAPE = .8500   DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .050   INPUT BETA= .050
E(N) = 49.88985   E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	11.292	0.000	46	64.481	44.281
2	12.464	0.000	47	65.663	45.463
3	13.647	0.000	48	66.846	46.646
4	14.829	0.000	49	68.028	47.828
5	16.011	0.000	50	69.210	49.010
6	17.193	0.000	51	70.392	50.192
7	18.375	0.000	52	71.574	51.374
8	19.558	0.000	53	72.757	52.557
9	20.740	.540	54	73.939	53.739
10	21.922	1.722	55	75.121	54.921
11	23.104	2.904	56	76.303	56.103
12	24.286	4.086	57	77.485	57.285
13	25.469	5.269	58	78.668	58.468
14	26.651	6.451	59	79.850	59.650
15	27.833	7.633	60	81.032	60.832
16	29.015	8.815	61	82.214	62.014
17	30.197	9.997	62	83.396	63.196
18	31.380	11.180	63	84.579	64.379
19	32.562	12.362	64	85.761	65.561
20	33.744	13.544	65	86.943	66.743
21	34.926	14.726	66	88.125	67.925
22	36.108	15.908	67	89.308	69.107
23	37.291	17.091	68	90.490	70.290
24	38.473	18.273	69	91.672	71.472
25	39.655	19.455	70	92.854	72.654
26	40.837	20.637	71	94.036	73.836
27	42.019	21.819	72	95.219	75.019
28	43.202	23.002	73	96.401	76.201
29	44.384	24.184	74	97.583	77.383
30	45.566	25.366	75	98.765	78.565
31	46.748	26.548	76	99.947	79.747
32	47.930	27.730	77	101.130	80.930
33	49.113	28.913	78	102.312	82.112
34	50.295	30.095	79	103.494	83.294
35	51.477	31.277	80	104.676	84.476
36	52.659	32.459	81	105.858	85.658
37	53.841	33.641	82	107.041	86.841
38	55.024	34.824	83	108.223	88.023
39	56.206	36.006	84	109.405	89.205
40	57.388	37.188	85	110.587	90.387
41	58.570	38.370	86	111.769	91.569
42	59.752	39.552	87	112.952	92.752
43	60.935	40.735	88	114.134	93.934
44	62.117	41.917	89	115.316	95.116
45	63.299	43.099	90	116.498	96.298

TEST	ACCEPT	REJECT
91	117.680	97.480
92	118.220	98.663
93	118.220	99.845
94	118.220	101.027
95	118.220	102.209
96	118.220	103.391
97	118.220	104.574
98	118.220	105.756
99	118.220	105.938
100	118.220	108.120

TEST I-15

K,SHAPE = .9000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .050 INPUT BETA= .050
E(N) = 44.78479 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	10.824	0.000	46	64.533	45.272
2	12.017	0.000	47	65.726	46.466
3	13.211	0.000	48	66.920	47.659
4	14.404	0.000	49	68.113	48.853
5	15.598	0.000	50	69.307	50.046
6	16.792	0.000	51	70.500	51.240
7	17.985	0.000	52	71.694	52.433
8	19.179	0.000	53	72.888	53.627
9	20.372	1.111	54	74.081	54.820
10	21.566	2.305	55	75.275	56.014
11	22.759	3.499	56	76.468	57.207
12	23.953	4.692	57	77.662	58.401
13	25.146	5.886	58	78.855	59.595
14	26.340	7.079	59	80.049	60.788
15	27.533	8.273	60	81.242	61.982
16	28.727	9.466	61	82.436	63.175
17	29.920	10.660	62	83.629	64.369
18	31.114	11.853	63	84.823	65.562
19	32.307	13.047	64	86.016	66.756
20	33.501	14.240	65	87.210	67.949
21	34.694	15.434	66	88.403	69.143
22	35.888	16.627	67	89.597	70.336
23	37.082	17.821	68	90.790	71.530
24	38.275	19.014	69	91.984	72.723
25	39.469	20.208	70	93.178	73.917
26	40.662	21.402	71	94.371	75.110
27	41.856	22.595	72	95.565	76.304
28	43.049	23.789	73	96.758	77.498
29	44.243	24.982	74	97.952	78.691
30	45.436	26.176	75	99.145	79.885
31	46.630	27.369	76	100.339	81.078
32	47.823	28.563	77	101.532	82.272
33	49.017	29.756	78	102.726	83.465
34	50.210	30.950	79	103.919	84.659
35	51.404	32.143	80	105.113	85.852
36	52.597	33.337	81	106.306	87.046
37	53.791	34.530	82	107.418	88.239
38	54.985	35.724	83	107.418	89.433
39	56.178	36.917	84	107.418	90.626
40	57.372	38.111	85	107.418	91.820
41	58.565	39.304	86	107.418	93.013
42	59.759	40.498	87	107.418	94.207
43	60.952	41.692	88	107.418	95.400
44	62.146	42.885	89	107.418	96.594
45	63.339	44.079	90	107.418	97.788

TEST I-16

K,SHAPE = .9500   DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .050   INPUT BETA= .050
E(N) = 40.45056   E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	10.416	0.000	46	64.637	46.216
2	11.620	0.000	47	65.842	47.421
3	12.825	0.000	48	67.047	48.625
4	14.030	0.000	49	68.252	49.831
5	15.235	0.000	50	69.457	51.035
6	16.440	0.000	51	70.662	52.241
7	17.645	0.000	52	71.867	53.446
8	18.850	.429	53	73.072	54.651
9	20.055	1.634	54	74.277	55.856
10	21.260	2.839	55	75.482	57.061
11	22.465	4.044	56	76.687	58.265
12	23.670	5.249	57	77.892	59.470
13	24.875	6.454	58	79.097	60.675
14	26.080	7.658	59	80.301	61.880
15	27.285	8.863	60	81.506	63.085
16	28.489	10.068	61	82.711	64.290
17	29.694	11.273	62	83.916	65.495
18	30.899	12.478	63	85.121	66.700
19	32.104	13.683	64	86.326	67.905
20	33.309	14.888	65	87.531	69.110
21	34.514	16.093	66	88.736	70.315
22	35.719	17.298	67	89.941	71.520
23	36.924	18.503	68	91.146	72.725
24	38.129	19.708	69	92.351	73.930
25	39.334	20.913	70	93.556	75.135
26	40.539	22.118	71	94.761	76.339
27	41.744	23.323	72	95.966	77.544
28	42.949	24.527	73	97.170	78.749
29	44.154	25.732	74	97.599	79.954
30	45.358	26.937	75	97.599	81.159
31	46.563	28.142	76	97.599	82.364
32	47.768	29.347	77	97.599	83.569
33	48.973	30.552	78	97.599	84.774
34	50.178	31.757	79	97.599	85.979
35	51.383	32.962	80	97.599	87.184
36	52.588	34.167	81	97.599	88.389
37	53.793	35.372			
38	54.998	36.577			
39	56.203	37.782			
40	57.408	38.987			
41	58.613	40.192			
42	59.818	41.396			
43	61.023	42.601			
44	62.227	43.806			
45	63.432	45.011			

TEST I-17

K,SHAPE =1.0000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .050 INPUT BETA= .050
E(N) = 36.73825 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	10.050	0.000	46	64.788	47.121
2	11.266	0.000	47	66.004	48.337
3	12.483	0.000	48	67.220	49.554
4	13.699	0.000	49	68.437	50.770
5	14.915	0.000	50	69.653	51.986
6	16.132	0.000	51	70.869	53.203
7	17.348	0.000	52	72.086	54.419
8	18.564	.898	53	73.302	55.636
9	19.781	2.114	54	74.519	56.852
10	20.997	3.331	55	75.735	58.068
11	22.214	4.547	56	76.951	59.285
12	23.430	5.763	57	78.168	60.501
13	24.646	6.980	58	79.384	61.718
14	25.863	8.196	59	80.601	62.934
15	27.079	9.413	60	81.817	64.150
16	28.296	10.629	61	83.033	65.367
17	29.512	11.845	62	84.250	66.583
18	30.728	13.062	63	85.466	67.800
19	31.945	14.278	64	86.683	69.016
20	33.161	15.495	65	87.899	70.232
21	34.378	16.711	66	89.115	71.449
22	35.594	17.927	67	90.013	72.665
23	36.810	19.144	68	90.013	73.882
24	38.027	20.360	69	90.013	75.098
25	39.243	21.577	70	90.013	76.314
26	40.460	22.793	71	90.013	77.531
27	41.676	24.009	72	90.013	78.747
28	42.892	25.226	73	90.013	79.964
29	44.109	26.442	74	90.013	81.180
30	45.325	27.659			
31	46.542	28.875			
32	47.758	30.091			
33	48.974	31.308			
34	50.191	32.524			
35	51.407	33.741			
36	52.624	34.957			
37	53.840	36.173			
38	55.056	37.390			
39	56.273	38.606			
40	57.489	39.822			
41	58.706	41.039			
42	59.922	42.255			
43	61.138	43.472			
44	62.355	44.688			
45	63.571	45.904			

TEST I-18

K,SHAPE =1.1000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .050 INPUT BETA= .050
E(N) = 30.74670 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	9.423	0.000	46	65.201	48.835
2	10.662	0.000	47	66.441	50.075
3	11.902	0.000	48	67.680	51.314
4	13.141	0.000	49	68.920	52.554
5	14.381	0.000	50	70.159	53.793
6	15.620	0.000	51	71.399	55.033
7	16.860	.494	52	72.638	56.272
8	18.099	1.733	53	73.878	57.512
9	19.339	2.973	54	75.118	58.752
10	20.578	4.212	55	76.357	59.991
11	21.818	5.452	56	76.851	61.231
12	23.057	6.691	57	76.851	62.470
13	24.297	7.931	58	76.851	63.710
14	25.536	9.170	59	76.851	64.949
15	26.776	10.410	60	76.851	66.189
16	28.015	11.649	61	76.851	67.428
17	29.255	12.889	62	76.851	68.668
18	30.495	14.129			
19	31.734	15.358			
20	32.974	16.608			
21	34.213	17.847			
22	35.453	19.087			
23	36.692	20.326			
24	37.932	21.566			
25	39.171	22.805			
26	40.411	24.045			
27	41.650	25.284			
28	42.890	26.524			
29	44.129	27.763			
30	45.369	29.003			
31	46.608	30.242			
32	47.848	31.482			
33	49.087	32.721			
34	50.327	33.961			
35	51.566	35.200			
36	52.806	36.440			
37	54.046	37.680			
38	55.285	38.919			
39	56.525	40.159			
40	57.764	41.398			
41	59.004	42.638			
42	60.243	43.877			
43	61.483	45.117			
44	62.722	46.356			
45	63.962	47.596			

TEST I-19

K,SHAPE =1.2000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .050 INPUT BETA= .050
E(N) = 26.16072 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	8.906	0.000	46	65.737	50.452
2	10.169	0.000	47	66.935	51.715
3	11.431	0.000	48	66.935	52.978
4	12.694	0.000	49	66.935	54.241
5	13.957	0.000	50	66.935	55.504
6	15.220	0.000	51	66.935	56.767
7	16.483	1.198	52	66.935	58.030
8	17.746	2.461	53	66.935	59.293
9	19.009	3.724			
10	20.272	4.987			
11	21.535	6.250			
12	22.798	7.512			
13	24.061	8.775			
14	25.324	10.038			
15	26.587	11.301			
16	27.850	12.564			
17	29.113	13.827			
18	30.375	15.090			
19	31.638	16.353			
20	32.901	17.616			
21	34.164	18.879			
22	35.427	20.142			
23	36.690	21.405			
24	37.953	22.668			
25	39.216	23.931			
26	40.479	25.193			
27	41.742	25.456			
28	43.005	27.719			
29	44.268	28.982			
30	45.531	30.245			
31	46.794	31.508			
32	48.056	32.771			
33	49.319	34.034			
34	50.582	35.297			
35	51.845	36.560			
36	53.108	37.823			
37	54.371	39.086			
38	55.634	40.349			
39	56.897	41.612			
40	58.160	42.874			
41	59.423	44.137			
42	60.686	45.400			
43	61.949	46.663			
44	63.212	47.926			
45	64.475	49.189			

TEST I-20

K,SHAPE =1.3000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .050 INPUT BETA= .050
E(N) = 22.56923 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	8.474	0.000	46	59.184	51.997
2	9.760	0.000			
3	11.047	0.000			
4	12.333	0.000			
5	13.620	0.000			
6	14.907	.533			
7	16.193	1.819			
8	17.480	3.106			
9	18.766	4.392			
10	20.053	5.679			
11	21.340	6.966			
12	22.626	8.252			
13	23.913	9.539			
14	25.199	10.825			
15	26.486	12.112			
16	27.773	13.399			
17	29.059	14.685			
18	30.346	15.972			
19	31.632	17.258			
20	32.919	18.545			
21	34.206	19.832			
22	35.492	21.118			
23	36.779	22.405			
24	38.065	23.691			
25	39.352	24.978			
26	40.639	26.265			
27	41.925	27.551			
28	43.212	28.838			
29	44.498	30.124			
30	45.785	31.411			
31	47.072	32.698			
32	48.358	33.984			
33	49.645	35.271			
34	50.931	36.557			
35	52.218	37.844			
36	53.505	39.131			
37	54.791	40.417			
38	56.078	41.704			
39	57.364	42.990			
40	58.651	44.277			
41	59.184	45.564			
42	59.184	46.850			
43	59.184	48.137			
44	59.184	49.423			
45	59.184	50.710			

TEST I-21

K,SHAPE =1.4000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .050 INPUT BETA= .050
E(N) = 19.70162 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	8.108	0.000
2	9.419	0.000
3	10.729	0.000
4	12.040	0.000
5	13.350	0.000
6	14.661	1.065
7	15.972	2.376
8	17.282	3.686
9	18.593	4.997
10	19.903	6.308
11	21.214	7.618
12	22.524	8.929
13	23.835	10.239
14	25.145	11.550
15	26.456	12.860
16	27.766	14.171
17	29.077	15.481
18	30.387	16.792
19	31.698	18.102
20	33.009	19.413
21	34.319	20.723
22	35.630	22.034
23	36.940	23.344
24	38.251	24.655
25	39.561	25.966
26	40.872	27.276
27	42.182	28.587
28	43.493	29.897
29	44.803	31.208
30	46.114	32.518
31	47.424	33.829
32	48.735	35.139
33	50.045	36.450
34	51.356	37.760
35	52.421	39.071
36	52.421	40.381
37	52.421	41.692
38	52.421	43.003
39	52.421	44.313
40	52.421	45.624

TEST I-22

K,SHAPE =1.5000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .050 INPUT BETA= .050
E(N) = 17.37375 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	7.797	0.000
2	9.131	0.000
3	10.466	0.000
4	11.801	0.000
5	13.135	.212
6	14.470	1.547
7	15.805	2.881
8	17.140	4.216
9	18.474	5.551
10	19.809	6.886
11	21.144	8.220
12	22.479	9.555
13	23.813	10.890
14	25.148	12.225
15	26.483	13.559
16	27.818	14.894
17	29.152	16.229
18	30.487	17.563
19	31.822	18.898
20	33.157	20.233
21	34.491	21.568
22	35.826	22.902
23	37.161	24.237
24	38.495	25.572
25	39.830	26.907
26	41.165	28.241
27	42.500	29.576
28	43.834	30.911
29	45.169	32.246
30	46.504	33.580
31	46.716	34.915
32	46.716	36.250
33	46.716	37.584
34	46.716	38.919
35	46.716	40.254

TEST I-23

K,SHAPE =1.6000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .050 INPUT BETA= .050
E(N) = 15.45674 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	7.528	0.000
2	8.887	0.000
3	10.247	0.000
4	11.606	0.000
5	12.965	.627
6	14.324	1.986
7	15.683	3.345
8	17.043	4.705
9	18.402	6.064
10	19.761	7.423
11	21.120	8.782
12	22.479	10.141
13	23.839	11.501
14	25.198	12.860
15	26.557	14.219
16	27.916	15.578
17	29.275	16.937
18	30.635	18.297
19	31.994	19.656
20	33.353	21.015
21	34.712	22.374
22	36.071	23.733
23	37.431	25.093
24	38.790	26.452
25	40.149	27.811
26	41.508	29.170
27	42.135	30.529
28	42.135	31.889
29	42.135	33.248
30	42.135	34.607
31	42.135	35.966

TEST I-24

K,SHAPE =1.7000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .050 INPUT BETA= .050
E(N) = 13.85816 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	7.296	0.000
2	8.680	0.000
3	10.064	0.000
4	11.447	0.000
5	12.831	1.008
6	14.215	2.392
7	15.599	3.776
8	16.983	5.150
9	18.367	6.544
10	19.751	7.928
11	21.135	9.311
12	22.519	10.695
13	23.903	12.079
14	25.287	13.463
15	26.671	14.847
16	28.055	16.231
17	29.439	17.615
18	30.822	18.999
19	32.206	20.383
20	33.590	21.767
21	34.974	23.151
22	36.358	24.535
23	37.742	25.919
24	38.750	27.303
25	38.750	28.686
26	38.750	30.070
27	38.750	31.454
28	38.750	32.838

TEST I-25

K,SHAPE =1.0000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .050 INPUT BETA= .050
E(N) = 12.51032 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	7.093	0.000
2	8.502	0.000
3	9.911	0.000
4	11.320	0.000
5	12.729	1.350
6	14.138	2.769
7	15.547	4.178
8	16.955	5.587
9	18.364	6.996
10	19.773	8.405
11	21.182	9.814
12	22.591	11.223
13	24.000	12.632
14	25.409	14.041
15	26.818	15.450
16	28.227	16.859
17	29.636	18.267
18	31.045	19.676
19	32.454	21.085
20	33.862	22.494
21	35.271	23.903
22	36.632	25.312
23	36.632	26.721
24	36.632	28.130
25	36.632	29.539
26	36.632	30.948

TEST I-26

K,SHAPE =1.9000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .050 INPUT BETA= .050
E(N) = 11.36258 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	6.916	0.000
2	8.350	0.000
3	9.784	0.000
4	11.218	.255
5	12.652	1.689
6	14.086	3.124
7	15.521	4.558
8	16.955	5.992
9	18.389	7.426
10	19.823	8.860
11	21.257	10.294
12	22.691	11.729
13	24.126	13.163
14	25.560	14.597
15	26.994	16.031
16	28.428	17.465
17	29.862	18.899
18	31.296	20.334
19	32.731	21.768
20	32.986	23.202
21	32.986	24.636
22	32.986	26.070
23	32.986	27.504

TEST I-27

K,SHAPE =2.0000   DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .050   INPUT BETA= .050
E(N) = 10.37689   E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	6.760	0.000
2	8.219	0.000
3	9.679	0.000
4	11.139	.539
5	12.598	1.998
6	14.058	3.458
7	15.518	4.918
8	16.977	6.377
9	18.437	7.837
10	19.897	9.297
11	21.356	10.756
12	22.816	12.216
13	24.276	13.676
14	25.735	15.135
15	27.195	16.595
16	28.655	18.055
17	30.114	19.514
18	30.653	20.974
19	30.653	22.434
20	30.653	23.893
21	30.653	25.353

TEST I-28

K,SHAPE =2.1000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .050 INPUT BETA= .050
E(N) = 9.52342 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	6.622	0.000
2	8.108	0.000
3	9.593	0.000
4	11.078	.805
5	12.564	2.290
6	14.049	3.776
7	15.535	5.261
8	17.020	6.747
9	18.506	8.232
10	19.991	9.718
11	21.477	11.203
12	22.962	12.689
13	24.447	14.174
14	25.933	15.659
15	27.418	17.145
16	28.904	18.630
17	29.709	20.116
18	29.709	21.601
19	29.709	23.087
20	29.709	24.572

TEST I-29

K,SHAPE =2.2000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .050 INPUT BETA= .050
E(N) = 8.77921 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	6.501	0.000
2	8.012	0.000
3	9.523	0.000
4	11.035	1.057
5	12.546	2.568
6	14.058	4.080
7	15.569	5.591
8	17.081	7.103
9	18.592	8.614
10	20.104	10.125
11	21.615	11.637
12	23.127	13.148
13	24.638	14.660
14	26.150	16.171
15	27.206	17.683
16	27.206	19.194
17	27.206	20.706
18	27.206	22.217

TEST I-30

K,SHAPE =2.3000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .050 INPUT BETA= .050
E(N) = 8.12606 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	6.393	0.000
2	7.931	0.000
3	9.468	0.000
4	11.006	1.296
5	12.544	2.834
6	14.082	4.371
7	15.619	5.909
8	17.157	7.447
9	18.695	8.984
10	20.232	10.522
11	21.770	12.060
12	23.308	13.598
13	24.846	15.135
14	26.141	16.673
15	26.141	18.211
16	26.141	19.749
17	26.141	21.286

TEST I-31

K,SHAPE =2.4000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .050 INPUT BETA= .050
E(N) = 7.54942 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	6.297	0.000
2	7.862	0.000
3	9.426	0.000
4	10.990	1.524
5	12.554	3.088
6	14.119	4.652
7	15.683	6.217
8	17.247	7.781
9	18.811	9.345
10	20.376	10.909
11	21.940	12.474
12	23.504	14.038
13	25.028	15.602
14	25.028	17.166
15	25.028	18.731
16	25.028	20.295

TEST I-32

K,SHAPE =2.5000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .050 INPUT BETA= .050
E(N) = 7.03756 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	6.213	0.000
2	7.804	0.000
3	9.395	.152
4	10.986	1.743
5	12.577	3.334
6	14.168	4.925
7	15.759	6.516
8	17.350	8.107
9	18.941	9.698
10	20.532	11.289
11	22.123	12.880
12	23.714	14.471
13	23.865	16.062
14	23.865	17.653
15	23.865	19.244

TEST I-33

K,SHAPE =2.8000   DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .050   INPUT BETA= .050
E(N) = 5.80341   E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	6.011	0.000
2	7.684	0.000
3	9.357	.680
4	11.030	2.353
5	12.703	4.026
6	14.375	5.698
7	16.048	7.371
8	17.721	9.044
9	19.394	10.717
10	20.074	12.390
11	20.074	14.053
12	20.074	15.735

TEST I-34

K,SHAPE =3.0000   DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .050   INPUT BETA= .050
E(N) = 5.16879   E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	5.913	0.000
2	7.641	0.000
3	9.370	1.001
4	11.098	2.730
5	12.827	4.459
6	14.556	6.187
7	16.284	7.916
8	18.013	9.644
9	19.014	11.373
10	19.014	13.101
11	19.014	14.830

TEST I-35

K,SHAPE =3.3000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .050 INPUT BETA= .050
E(N) = 4.41375 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	5.806	0.000
2	7.620	0.000
3	9.434	1.450
4	11.247	3.264
5	13.061	5.078
6	14.875	6.892
7	16.325	8.706
8	16.325	10.520
9	16.325	12.334

TEST I-36

K,SHAPE =3.6000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .050 INPUT BETA= .050
E(N) = 3.82955 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	5.737	0.000
2	7.638	0.000
3	9.540	1.859
4	11.441	3.770
5	13.342	5.671
6	15.211	7.573
7	15.211	9.474
8	15.211	11.376

TEST I-37

K,SHAPE =3.9000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .050 INPUT BETA= .050
E(N) = 3.36713 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	5.598	0.000
2	7.689	.275
3	9.679	2.266
4	11.670	4.256
5	13.661	6.247
6	13.936	8.238
7	13.936	10.229

TEST I-38

K,SHAPE =4.3000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .050 INPUT BETA= .050
E(N) = 2.88543 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	5.682	0.000
2	7.795	.658
3	9.908	2.771
4	12.021	4.884
5	12.679	6.997
6	12.679	9.110

TEST I-39

K,SHAPE =4.6000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .050 INPUT BETA= .050
E(N) = 2.59800 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	5.691	0.000
2	7.898	.930
3	10.105	3.137
4	12.312	5.344
5	13.242	7.551
6	13.242	9.758

TEST I-40

K,SHAPE =5.7000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .050 INPUT BETA= .050
E(N) = 1.87903 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	5.834	0.000
2	8.400	1.863
3	10.262	4.428
4	10.262	6.994

Appendix C

Performance Evaluation Tables for SPRT's with Designated Risks of .10

ACCELERATED TEST W/O REPLACEMENT
INPUT ALPHA= .100 INPUT BETA= .100
MULTIPLICATION FACTOR= 1.50 NMAX= 5000

K	ALPHA	BETA	N(0)	N(1)	T(0)	T(1)
.50	.128	.133	75.49	82.69	5.858	6.842
.52	.133	.124	70.40	77.87	5.313	6.125
.54	.127	.115	64.70	71.83	4.588	5.203
.56	.129	.118	61.11	67.89	4.387	4.950
.58	.145	.119	57.87	63.23	4.145	4.305
.60	.142	.117	53.76	58.83	3.809	3.865
.63	.137	.112	49.30	54.55	3.309	3.437
.65	.136	.115	44.88	50.65	2.993	3.140
.68	.143	.123	42.32	47.48	2.944	2.976
.70	.139	.114	39.86	44.47	2.797	2.687
.73	.137	.114	37.08	41.74	2.533	2.516
.75	.139	.109	34.37	39.55	2.452	2.367
.80	.139	.109	31.04	35.07	2.315	2.147
.85	.132	.122	27.39	31.49	2.137	1.953
.90	.138	.116	24.20	28.73	1.980	1.856
.95	.143	.106	22.19	25.73	1.903	1.630
1.00	.144	.114	20.10	23.67	1.850	1.611
1.10	.148	.103	16.67	19.93	1.728	1.445
1.20	.130	.097	14.37	17.28	1.642	1.314
1.30	.140	.100	12.40	15.02	1.609	1.271
1.40	.137	.100	10.67	13.23	1.562	1.228
1.50	.136	.089	9.48	11.93	1.516	1.178
1.60	.128	.092	8.47	10.74	1.509	1.153
1.70	.132	.093	7.55	9.65	1.509	1.146
1.80	.127	.083	6.84	8.84	1.466	1.096
1.90	.128	.080	6.30	8.18	1.455	1.077
2.00	.129	.078	5.87	7.58	1.453	1.063
2.10	.125	.077	5.27	6.93	1.436	1.048
2.20	.124	.073	4.83	6.44	1.431	1.062
2.30	.114	.068	4.58	6.16	1.400	1.007
2.40	.123	.068	4.27	5.73	1.402	1.030
2.50	.121	.063	4.06	5.45	1.374	.983
2.80	.127	.068	3.27	4.54	1.363	1.029
3.00	.107	.056	3.10	4.27	1.341	.977
3.30	.113	.051	2.64	3.68	1.311	.970
3.60	.113	.059	2.28	3.15	1.292	.987
3.90	.102	.042	2.16	2.96	1.275	.953
4.30	.118	.045	1.82	2.52	1.249	.989
4.60	.103	.041	1.78	2.43	1.244	.973
5.70	.100	.036	1.37	1.87	1.193	.975

ACCELERATED TEST W/O REPLACEMENT
INPUT ALPHA= .100 INPUT BETA= .100
MULTIPLICATION FACTOR= 2.00 NMAX= 5000

K	ALPHA	BETA	N(0)	N(1)	T(0)	T(1)
.50	.112	.109	81.05	89.77	3.412	3.981
.52	.116	.106	76.32	84.95	3.392	3.927
.54	.119	.098	70.41	78.44	2.913	3.335
.56	.114	.101	66.75	72.77	2.847	2.856
.58	.122	.101	62.58	67.93	2.713	2.666
.60	.110	.100	58.42	64.29	2.421	2.470
.63	.127	.099	53.88	59.34	2.352	2.229
.65	.120	.093	50.20	55.51	2.125	1.982
.68	.125	.097	46.63	51.92	2.030	1.880
.70	.112	.094	42.46	47.94	1.815	1.704
.73	.120	.090	39.82	45.50	1.740	1.711
.75	.119	.102	37.75	43.27	1.722	1.647
.80	.117	.097	33.16	38.38	1.586	1.439
.85	.111	.089	29.62	33.91	1.499	1.299
.90	.119	.090	26.99	31.03	1.492	1.289
.95	.114	.093	23.99	28.00	1.430	1.200
1.00	.118	.088	21.78	25.68	1.395	1.158
1.10	.121	.084	18.34	21.58	1.372	1.072
1.20	.117	.082	15.79	18.54	1.358	1.022
1.30	.112	.077	13.32	16.40	1.331	1.012
1.40	.108	.079	11.81	14.57	1.296	.965
1.50	.106	.077	10.42	12.95	1.288	.946
1.60	.110	.072	9.39	11.47	1.317	.926
1.70	.109	.072	8.26	10.52	1.294	.924
1.80	.106	.069	7.51	9.53	1.308	.916
1.90	.115	.069	6.95	8.83	1.287	.897
2.00	.111	.065	6.24	8.28	1.323	.945
2.10	.096	.066	5.70	7.57	1.311	.925
2.20	.100	.067	5.34	6.88	1.321	.902
2.30	.105	.066	4.91	6.53	1.323	.922
2.40	.099	.054	4.66	6.16	1.292	.873
2.50	.103	.057	4.35	5.84	1.303	.901
2.80	.095	.052	3.63	4.91	1.315	.908
3.00	.097	.051	3.26	4.45	1.315	.921
3.30	.092	.046	2.76	3.90	1.294	.922
3.60	.082	.030	2.53	3.49	1.266	.863
3.90	.083	.033	2.24	3.14	1.263	.894
4.30	.080	.039	1.97	2.76	1.254	.927
4.60	.081	.024	1.89	2.63	1.242	.910
5.70	.063	.018	1.51	2.11	1.204	.912

ACCELERATED TESTS WITH REPLACEMENT
MONTE CARLO SIZE= 1000
INPUT ALPHA= .100 INPUT BETA= .100
MULTIPLICATION FACTOR= 2.00 NSTAND= 1

K	ALPHA	BETA	N(0)	N(1)	T(0)	T(1)
.50	.105	.103	80.70	91.87	245.891	184.218
.52	.116	.109	78.27	87.01	219.301	163.733
.54	.111	.108	72.70	79.33	190.383	139.224
.56	.100	.096	67.37	75.04	167.365	124.687
.58	.097	.120	61.42	66.24	146.260	105.369
.60	.104	.131	58.64	66.07	133.252	101.437
.63	.116	.099	53.65	60.02	115.159	85.868
.65	.124	.091	50.63	55.90	102.414	76.074
.68	.113	.105	45.14	51.78	89.266	68.193
.70	.107	.088	43.03	48.36	82.106	60.998
.73	.124	.100	38.89	45.57	71.946	56.170
.75	.110	.095	36.48	43.75	65.722	52.351
.80	.119	.091	33.76	38.26	57.126	43.353
.85	.106	.074	29.84	34.89	48.656	37.784
.90	.099	.083	26.32	30.44	41.965	31.684
.95	.118	.084	24.45	27.70	37.321	28.107
1.00	.115	.097	22.34	25.37	33.440	25.379
1.10	.129	.084	18.38	22.08	26.462	21.351
1.20	.107	.080	15.46	18.46	21.834	17.273
1.30	.118	.085	13.37	16.30	18.413	15.084
1.40	.108	.060	12.20	14.68	16.517	13.339
1.50	.118	.074	10.50	13.06	14.144	11.806
1.60	.096	.070	9.19	11.17	12.439	9.926
1.70	.097	.074	8.32	10.36	11.148	9.260
1.80	.108	.059	7.60	9.84	10.106	8.794
1.90	.107	.063	6.81	8.73	9.083	7.725
2.00	.120	.058	6.23	7.88	8.263	6.862
2.10	.104	.057	5.82	7.51	7.748	6.638
2.20	.105	.062	5.29	7.00	7.019	6.193
2.30	.093	.053	4.93	6.48	6.554	5.706
2.40	.107	.058	4.63	6.14	6.116	5.438
2.50	.082	.062	4.28	5.86	5.758	5.233
2.80	.111	.061	3.64	4.85	4.816	4.319
3.00	.086	.047	3.26	4.54	4.388	4.082
3.30	.099	.036	2.85	3.83	3.825	3.428
3.60	.096	.039	2.52	3.57	3.396	3.226
3.90	.083	.036	2.25	3.22	3.075	2.937
4.30	.078	.024	1.94	2.75	2.674	2.486
4.60	.064	.019	1.85	2.67	2.550	2.432
5.70	.062	.019	1.52	2.11	2.104	1.952

ACCELERATED TESTS WITH REPLACEMENT
MONTE CARLO SIZE = 1000
INPUT ALPHA= .100 INPUT BETA= .100
MULTIPLICATION FACTOR= 2.00 NSTAND= 2

K	ALPHA	BETA	N(0)	N(1)	T(0)	T(1)
.50	.102	.086	80.51	92.22	118.246	90.504
.52	.124	.110	76.66	86.72	104.078	80.253
.54	.106	.096	72.60	79.05	92.152	68.070
.56	.109	.096	65.96	74.64	79.873	60.903
.58	.111	.124	60.00	67.40	69.460	53.073
.60	.100	.116	58.33	67.13	64.594	50.678
.63	.110	.096	53.58	59.35	56.177	41.868
.65	.121	.088	49.53	55.01	49.452	36.899
.68	.122	.099	45.20	51.76	43.679	33.650
.70	.122	.098	41.79	47.85	39.072	29.847
.73	.116	.102	38.70	45.55	35.279	27.894
.75	.099	.095	36.81	42.67	32.763	25.239
.80	.118	.096	34.10	38.25	28.485	21.531
.85	.100	.096	30.76	34.12	24.842	18.498
.90	.116	.073	26.43	30.45	20.806	15.756
.95	.121	.082	24.13	27.69	18.381	14.069
1.00	.115	.079	21.81	25.63	16.362	12.714
1.10	.107	.087	17.67	21.44	13.020	10.341
1.20	.120	.079	16.04	18.75	11.385	8.975
1.30	.121	.074	13.47	16.16	9.477	7.491
1.40	.099	.081	11.80	14.35	8.336	6.548
1.50	.116	.078	10.66	12.64	7.415	5.799
1.60	.110	.062	9.32	11.74	6.554	5.376
1.70	.101	.076	8.19	10.36	5.793	4.724
1.80	.137	.068	7.74	9.59	5.380	4.399
1.90	.111	.074	6.97	8.63	4.954	3.936
2.00	.101	.048	6.29	7.97	4.517	3.520
2.10	.092	.073	5.62	7.53	4.137	3.504
2.20	.116	.068	5.34	7.19	3.883	3.371
2.30	.096	.050	5.04	6.58	3.716	3.051
2.40	.085	.044	4.65	6.27	3.508	2.910
2.50	.095	.060	4.42	5.79	3.330	2.724
2.80	.090	.049	3.71	4.99	2.870	2.383
3.00	.093	.053	3.22	4.53	2.578	2.214
3.30	.109	.051	2.88	3.84	2.337	1.883
3.60	.096	.032	2.57	3.57	2.165	1.780
3.90	.073	.035	2.28	3.13	1.996	1.577
4.30	.089	.031	2.06	2.77	1.823	1.422
4.60	.069	.022	1.93	2.60	1.772	1.334
5.70	.070	.016	1.46	2.09	1.515	1.128

ACCELERATED TESTS WITH REPLACEMENT
MONTE CARLO SIZE = 1000
INPUT ALPHA= .100 INPUT BETA= .100
MULTIPLICATION FACTOR= 2.00 NSTAND= 3

K	ALPHA	BETA	N(0)	N(1)	T(0)	T(1)
.50	.108	.091	79.47	91.83	75.305	58.351
.52	.124	.109	75.06	86.76	66.083	52.550
.54	.118	.092	71.29	79.38	58.833	44.843
.56	.109	.090	66.38	75.14	52.223	40.263
.58	.117	.111	59.74	68.71	44.881	35.464
.60	.100	.115	58.10	66.07	42.096	32.550
.63	.119	.089	52.95	60.06	36.285	27.835
.65	.128	.094	49.26	54.63	32.108	24.147
.68	.122	.098	45.38	52.57	28.648	22.571
.70	.132	.093	42.90	49.79	26.013	20.743
.73	.118	.111	40.17	44.66	23.873	18.060
.75	.104	.083	37.93	41.89	22.071	16.215
.80	.095	.082	33.15	38.12	18.498	14.095
.85	.113	.096	30.22	34.03	16.105	12.245
.90	.129	.081	26.92	30.66	13.866	10.598
.95	.114	.097	24.30	27.83	12.310	9.490
1.00	.120	.089	22.13	25.92	10.993	8.659
1.10	.105	.083	18.49	21.15	9.013	6.813
1.20	.129	.084	15.51	18.47	7.482	5.855
1.30	.122	.085	13.13	15.99	6.319	5.007
1.40	.109	.072	11.82	14.55	5.688	4.539
1.50	.100	.083	10.18	12.80	4.982	3.980
1.60	.132	.069	9.44	11.50	4.535	3.565
1.70	.103	.060	8.15	10.63	4.023	3.308
1.80	.111	.076	7.50	9.78	3.722	3.098
1.90	.101	.059	7.00	8.78	3.529	2.763
2.00	.100	.072	6.14	8.11	3.173	2.579
2.10	.105	.058	5.89	7.47	3.052	2.384
2.20	.096	.061	5.39	7.14	2.841	2.315
2.30	.126	.058	4.88	6.47	2.621	2.105
2.40	.092	.054	4.64	6.15	2.542	1.998
2.50	.098	.059	4.29	5.78	2.391	1.908
2.80	.088	.052	3.52	4.88	2.105	1.658
3.00	.097	.050	3.28	4.41	1.984	1.530
3.30	.095	.044	2.86	3.88	1.819	1.381
3.60	.070	.048	2.58	3.59	1.725	1.319
3.90	.072	.030	2.20	3.16	1.575	1.186
4.30	.089	.028	1.95	2.78	1.481	1.095
4.60	.077	.027	1.88	2.61	1.459	1.055
5.70	.064	.012	1.55	2.12	1.333	.913

ACCELERATED TESTS WITH REPLACEMENT
MONTE CARLO SIZE = 1000
INPUT ALPHA= .100 INPUT BETA= .100
MULTIPLICATION FACTOR= 2.00 NSTAND= 5

K	ALPHA	BETA	N(0)	N(1)	T(0)	T(1)
.50	.111	.097	79.81	92.54	43.002	34.316
.52	.121	.104	75.55	87.94	37.969	31.006
.54	.113	.106	70.97	79.23	33.614	26.044
.56	.104	.094	65.76	75.87	29.811	23.675
.58	.125	.110	59.87	67.85	25.841	20.314
.60	.100	.107	57.04	66.51	23.740	19.141
.63	.107	.091	53.63	59.50	21.218	16.039
.65	.125	.104	49.58	55.21	18.791	14.417
.68	.121	.090	45.10	53.28	16.521	13.416
.70	.115	.109	42.52	48.38	15.153	11.360
.73	.107	.091	39.05	46.32	13.621	10.980
.75	.115	.095	38.27	42.52	12.898	9.819
.80	.112	.104	34.30	39.28	11.125	8.789
.85	.142	.078	30.29	34.93	9.432	7.427
.90	.114	.090	26.69	31.26	8.235	6.501
.95	.108	.083	24.03	27.79	7.289	5.608
1.00	.113	.087	21.72	25.28	6.538	5.022
1.10	.113	.101	18.15	21.30	5.373	4.181
1.20	.111	.077	15.75	18.76	4.648	3.621
1.30	.141	.072	14.02	16.20	4.082	3.098
1.40	.112	.076	11.66	14.58	3.511	2.815
1.50	.122	.069	10.49	12.68	3.190	2.441
1.60	.091	.066	9.11	11.59	2.876	2.252
1.70	.100	.068	8.46	10.59	2.680	2.082
1.80	.110	.073	7.47	9.50	2.443	1.887
1.90	.114	.069	6.96	9.05	2.317	1.840
2.00	.107	.055	6.08	8.20	2.107	1.674
2.10	.098	.063	5.68	7.58	2.025	1.576
2.20	.107	.060	5.19	6.99	1.907	1.469
2.30	.111	.051	4.88	6.49	1.823	1.390
2.40	.082	.045	4.75	6.24	1.822	1.349
2.50	.114	.071	4.52	5.77	1.725	1.289
2.80	.099	.051	3.66	4.95	1.554	1.157
3.00	.093	.041	3.23	4.41	1.466	1.057
3.30	.105	.038	2.78	3.86	1.366	.984
3.60	.093	.040	2.68	3.50	1.354	.935
3.90	.079	.032	2.24	3.17	1.271	.896
4.30	.095	.041	1.93	2.79	1.218	.865
4.60	.068	.028	1.80	2.65	1.215	.855
5.70	.072	.021	1.48	2.10	1.186	.812

ACCELERATED TESTS WITH REPLACEMENT
MONTE CARLO SIZE= 5000
INPUT ALPHA= .100 INPUT BETA= .100
MULTIPLICATION FACTOR= 2.00 NSTAND= 1

K	ALPHA	BETA	N(0)	N(1)	T(0)	T(1)
.50	.112	.113	82.29	91.10	248.197	183.506
1.00	.107	.082	21.55	25.59	32.486	25.475
1.30	.114	.082	13.39	16.39	18.563	15.156
1.60	.111	.075	9.21	11.59	12.367	10.407
2.00	.107	.067	6.19	8.16	8.229	7.252
2.20	.103	.060	5.36	6.97	7.118	6.155
2.50	.097	.046	4.27	5.85	5.701	5.179
3.30	.100	.042	2.77	3.87	3.736	3.462
4.30	.086	.032	1.99	2.76	2.715	2.514
5.70	.062	.020	1.48	2.10	2.063	1.947

ACCELERATED TESTS WITH REPLACEMENT
MONTE CARLO SIZE = 5000
INPUT ALPHA= .100 INPUT BETA= .100
MULTIPLICATION FACTOR= 2.00 NSTAND= 2

K	ALPHA	BETA	N(0)	N(1)	T(0)	T(1)
.50	.104	.112	82.97	91.59	120.690	90.733
1.00	.114	.086	21.76	25.75	16.325	12.849
1.30	.117	.078	13.16	16.39	9.338	7.643
1.60	.107	.075	9.16	11.52	6.463	5.274
2.00	.104	.070	6.22	3.07	4.491	3.711
2.20	.106	.057	5.22	6.99	3.845	3.229
2.50	.101	.054	4.36	5.86	3.280	2.752
3.30	.096	.041	2.79	3.84	2.299	1.877
4.30	.085	.031	1.98	2.75	1.797	1.415
5.70	.071	.018	1.52	2.10	1.535	1.129

ACCELERATED TESTS WITH REPLACEMENT
MONTE CARLO SIZE = 5000
INPUT ALPHA= .100 INPUT BETA= .100
MULTIPLICATION FACTOR= 2.00 NSTAND= 5

K	ALPHA	BETA	N(0)	N(1)	T(0)	T(1)
.50	.113	.108	82.05	92.14	43.912	34.439
1.00	.115	.089	21.78	25.61	6.535	5.124
1.30	.112	.082	13.29	16.26	3.960	3.132
1.60	.109	.072	9.17	11.64	2.874	2.270
2.00	.109	.067	6.24	8.14	2.141	1.671
2.20	.117	.059	5.40	6.97	1.939	1.469
2.50	.097	.049	4.31	5.83	1.706	1.288
3.30	.105	.043	2.81	3.83	1.371	.976
4.30	.086	.037	1.96	2.78	1.224	.863
5.70	.066	.019	1.50	2.11	1.192	.815

ACCELERATED TESTS WITH REPLACEMENT
MONTE CARLO SIZE = 5000
INPUT ALPHA= .100 INPUT BETA= .100
MULTIPLICATION FACTOR= 2.00 NSTAND= 7

K	ALPHA	BETA	N(0)	N(1)	T(0)	T(1)
.50	.110	.109	81.98	91.98	29.923	23.668
1.00	.119	.091	21.71	25.38	4.649	3.620
1.30	.114	.087	13.12	16.27	2.880	2.289
1.60	.111	.065	9.27	11.67	2.179	1.688
2.00	.112	.061	6.25	8.13	1.679	1.275
2.20	.098	.061	5.33	7.01	1.542	1.153
2.50	.102	.049	4.36	5.86	1.392	1.031
3.30	.102	.043	2.81	3.87	1.183	.838
4.30	.084	.033	1.98	2.75	1.121	.776
5.70	.067	.016	1.52	2.10	1.118	.759

ACCELERATED TESTS WITH REPLACEMENT
MONTE CARLO SIZE = 5000
INPUT ALPHA= .100 INPUT BETA= .100
MULTIPLICATION FACTOR= 2.00 NSTAND= 10

K	ALPHA	BETA	N(0)	N(1)	T(0)	T(1)
.50	.113	.113	81.94	91.94	19.623	15.729
1.00	.116	.089	21.94	25.74	3.282	2.578
1.30	.114	.080	13.20	16.36	2.102	1.655
1.60	.109	.072	9.19	11.46	1.633	1.236
2.00	.099	.066	6.22	8.05	1.323	.980
2.20	.101	.056	5.24	6.99	1.228	.905
2.50	.092	.051	4.36	5.81	1.154	.829
3.30	.091	.043	2.79	3.86	1.041	.727
4.30	.084	.035	1.99	2.75	1.023	.709
5.70	.066	.019	1.50	2.12	1.045	.714

ACCELERATED TESTS WITH REPLACEMENT
MONTE CARLO SIZE = 5000
INPUT ALPHA= .100 INPUT BETA= .100
MULTIPLICATION FACTOR= 2.00 NSTAND= 15

K	ALPHA	BETA	N(0)	N(1)	T(0)	T(1)
.50	.109	.113	82.42	91.79	12.024	9.652
1.00	.115	.088	21.61	25.57	2.162	1.704
1.30	.110	.080	13.30	16.18	1.483	1.140
1.60	.112	.079	9.25	11.54	1.206	.911
2.00	.104	.064	6.20	8.10	1.026	.757
2.20	.107	.057	5.32	7.01	.981	.715
2.50	.097	.059	4.38	5.85	.945	.683
3.30	.098	.046	2.78	3.88	.901	.635
4.30	.087	.034	2.00	2.77	.923	.642
5.70	.061	.023	1.50	2.10	.974	.662

Appendix D

<u>Test Plans for Weibull SPRT's</u>

<u>with Designated Risks of .10</u>

TEST II-1

K,SHAPE = .5000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .100 INPUT BETA= .100
E(N) = 91.41231 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	13.079	0.000	46	62.794	38.847
2	14.183	0.000	47	63.899	39.951
3	15.288	0.000	48	65.004	41.056
4	16.393	0.000	49	66.108	42.161
5	17.498	0.000	50	67.213	43.266
6	18.602	0.000	51	68.318	44.370
7	19.707	0.000	52	69.423	45.475
8	20.812	0.000	53	70.528	46.580
9	21.917	0.000	54	71.632	47.685
10	23.022	0.000	55	72.737	48.790
11	24.126	.179	56	73.842	49.894
12	25.231	1.284	57	74.947	50.999
13	26.336	2.389	58	76.052	52.104
14	27.441	3.493	59	77.156	53.209
15	28.545	4.598	60	78.261	54.314
16	29.650	5.703	61	79.366	55.418
17	30.755	6.808	62	80.471	56.523
18	31.860	7.912	63	81.575	57.628
19	32.965	9.017	64	82.680	58.733
20	34.070	10.122	65	83.785	59.838
21	35.174	11.227	66	84.890	60.942
22	36.279	12.332	67	85.995	62.047
23	37.384	13.436	68	87.099	63.152
24	38.489	14.541	69	88.204	64.257
25	39.593	15.646	70	89.309	65.361
26	40.698	16.751	71	90.414	66.466
27	41.803	17.856	72	91.519	67.571
28	42.908	18.960	73	92.623	68.676
29	44.013	20.065	74	93.728	69.781
30	45.117	21.170	75	94.833	70.885
31	46.222	22.275	76	95.938	71.990
32	47.327	23.379	77	97.043	73.095
33	48.432	24.484	78	98.147	74.200
34	49.537	25.589	79	99.252	75.305
35	50.641	26.694	80	100.357	76.409
36	51.746	27.799	81	101.462	77.514
37	52.851	28.903	82	102.566	78.619
38	53.956	30.008	83	103.671	79.724
39	55.061	31.113	84	104.776	80.829
40	56.165	32.218	85	105.881	81.933
41	57.270	33.323	86	106.986	83.038
42	58.375	34.427	87	108.090	84.143
43	59.480	35.532	88	109.195	85.248
44	60.584	36.637	89	110.300	86.352
45	61.689	37.742	90	111.405	87.457

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
91	112.510	88.552	136	162.225	138.278
92	113.614	89.657	137	163.330	139.382
93	114.719	90.772	138	164.435	140.487
94	115.824	91.876	139	165.539	141.592
95	116.929	92.981	140	166.644	142.697
96	118.033	94.086	141	167.749	143.801
97	119.138	95.191	142	168.854	144.906
98	120.243	96.296	143	169.959	146.011
99	121.348	97.400	144	171.063	147.116
100	122.453	98.505	145	172.168	148.221
101	123.557	99.610	146	173.273	149.325
102	124.662	100.715	147	174.378	150.430
103	125.767	101.820	148	175.483	151.535
104	126.872	102.924	149	176.587	152.640
105	127.977	104.029	150	177.692	153.745
106	129.081	105.134	151	178.797	154.849
107	130.186	106.239	152	179.902	155.954
108	131.291	107.343	153	181.006	157.059
109	132.396	108.448	154	182.111	158.164
110	133.501	109.553	155	183.216	159.269
111	134.605	110.658	156	184.321	160.373
112	135.710	111.763	157	185.426	161.478
113	136.815	112.867	158	186.530	162.583
114	137.920	113.972	159	187.635	163.688
115	139.024	115.077	160	188.740	164.792
116	140.129	116.182	161	189.845	165.897
117	141.234	117.287	162	190.950	167.002
118	142.339	118.391	163	192.054	168.107
119	143.444	119.496	164	193.159	169.212
120	144.548	120.601	165	194.264	170.316
121	145.653	121.706	166	195.369	171.421
122	146.758	122.811	167	196.474	172.526
123	147.863	123.915	168	197.578	173.631
124	148.968	125.020	169	198.683	174.736
125	150.072	126.125	170	199.788	175.840
126	151.177	127.230	171	200.893	176.945
127	152.282	128.334	172	201.997	178.050
128	153.387	129.439	173	202.176	179.155
129	154.492	130.544	174	202.176	180.260
130	155.596	131.649	175	202.176	181.364
131	156.701	132.754	176	202.176	182.469
132	157.806	133.858	177	202.176	183.574
133	158.911	134.963	178	202.175	184.679
134	160.015	136.068	179	202.175	185.783
135	161.120	137.173	180	202.175	186.888

TEST	ACCEPT	REJECT
181	202.175	187.993
182	202.175	189.098
183	202.176	190.203

TEST II-2

K,SHAPE = .5200 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .100 INPUT BETA= .100
E(N) = 84.73580 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	12.668	0.000	46	62.578	39.461
2	13.777	0.000	47	63.687	40.570
3	14.886	0.000	48	64.796	41.680
4	15.995	0.000	49	65.905	42.789
5	17.104	0.000	50	67.015	43.898
6	18.213	0.000	51	68.124	45.007
7	19.322	0.000	52	69.233	46.116
8	20.431	0.000	53	70.342	47.225
9	21.540	0.000	54	71.451	48.334
10	22.650	0.000	55	72.560	49.443
11	23.759	.642	56	73.669	50.552
12	24.868	1.751	57	74.778	51.562
13	25.977	2.860	58	75.888	52.771
14	27.086	3.969	59	76.997	53.880
15	28.195	5.078	60	78.106	54.989
16	29.304	6.188	61	79.215	56.098
17	30.413	7.297	62	80.324	57.207
18	31.523	8.406	63	81.433	58.316
19	32.632	9.515	64	82.542	59.425
20	33.741	10.624	65	83.651	60.535
21	34.850	11.733	66	84.760	61.644
22	35.959	12.842	67	85.870	62.753
23	37.068	13.951	68	86.979	63.862
24	38.177	15.061	69	88.088	64.971
25	39.286	16.170	70	89.197	66.080
26	40.395	17.279	71	90.306	67.189
27	41.505	18.388	72	91.415	68.298
28	42.614	19.497	73	92.524	69.408
29	43.723	20.606	74	93.633	70.517
30	44.832	21.715	75	94.743	71.626
31	45.941	22.824	76	95.852	72.735
32	47.050	23.934	77	96.961	73.844
33	48.159	25.043	78	98.070	74.953
34	49.269	26.152	79	99.179	76.062
35	50.378	27.261	80	100.288	77.171
36	51.487	28.370	81	101.397	78.281
37	52.596	29.479	82	102.506	79.390
38	53.705	30.588	83	103.616	80.499
39	54.814	31.697	84	104.725	81.608
40	55.923	32.807	85	105.834	82.717
41	57.032	33.916	86	106.943	83.826
42	58.142	35.025	87	108.052	84.935
43	59.251	36.134	88	109.161	86.044
44	60.360	37.243	89	110.270	87.154
45	61.469	38.352	90	111.379	88.263

AD-A034 999   AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OHIO SCH--ETC F/G 12/1
SEQUENTIAL PROBABILITY RATIO TESTS OF THE SCALE PARAMETER BETWE--ETC(U)
DEC 76 J N ROBINSON

UNCLASSIFIED   GOR/MA/76D-2   NL

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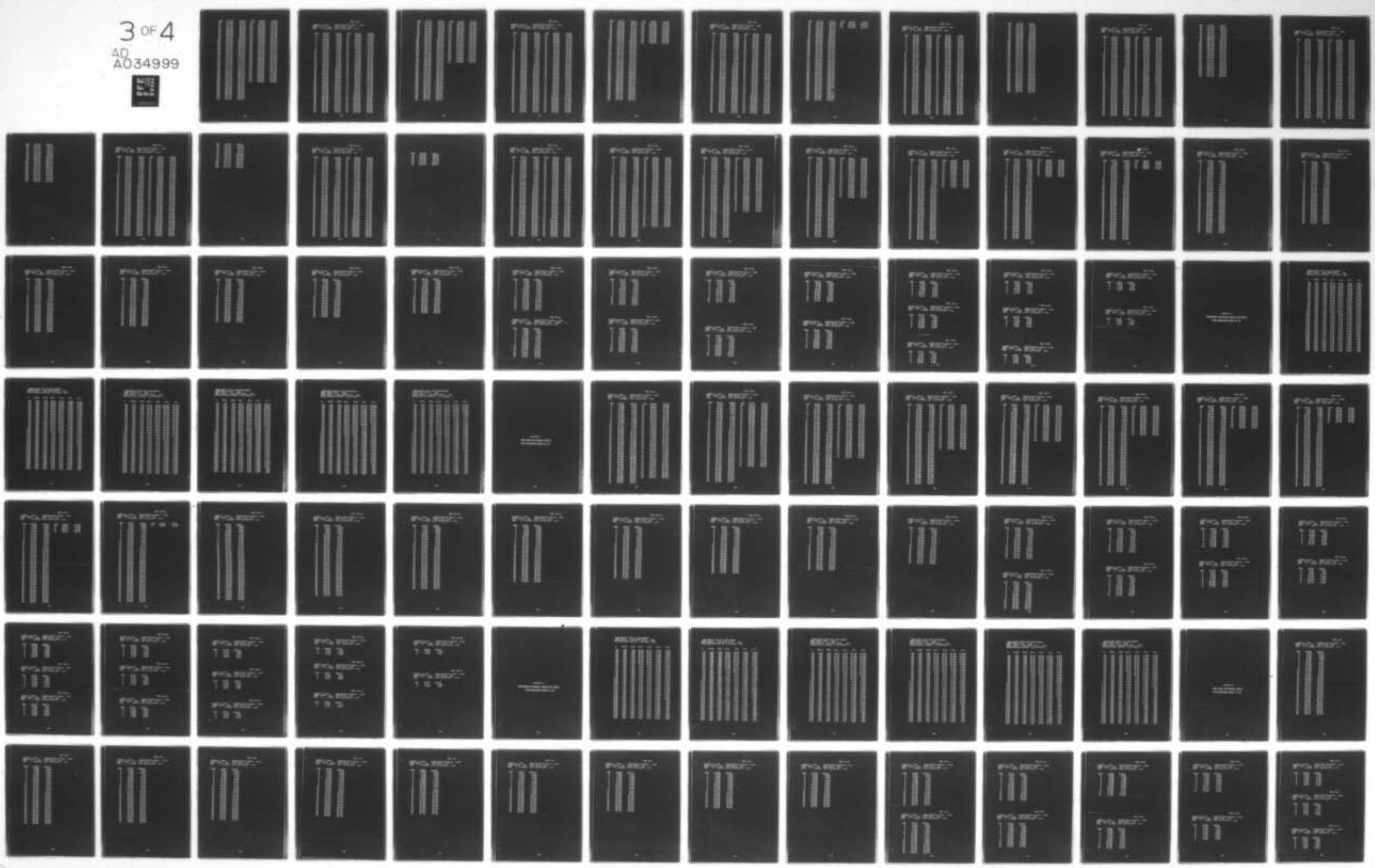

TEST	ACCEPT	REJECT
91	112.489	89.372
92	113.598	90.481
93	114.707	91.590
94	115.816	92.699
95	116.925	93.808
96	118.034	94.917
97	119.143	96.027
98	120.252	97.136
99	121.362	98.245
100	122.471	99.354
101	123.580	100.463
102	124.689	101.572
103	125.798	102.681
104	126.907	103.790
105	128.016	104.899
106	129.125	106.009
107	130.235	107.118
108	131.344	108.227
109	132.453	109.336
110	133.562	110.445
111	134.671	111.554
112	135.780	112.663
113	136.889	113.772
114	137.998	114.882
115	139.107	115.991
116	140.217	117.100
117	141.326	118.209
118	142.435	119.318
119	143.544	120.427
120	144.653	121.536
121	145.762	122.645
122	146.871	123.755
123	147.980	124.864
124	149.090	125.973
125	150.199	127.082
126	151.308	128.191
127	152.417	129.300
128	153.526	130.409
129	154.635	131.518
130	155.744	132.628
131	156.853	133.737
132	157.963	134.846
133	159.072	135.955
134	160.181	137.064
135	161.290	138.173
136	162.399	139.282
137	163.508	140.391
138	164.617	141.501
139	165.726	142.610
140	166.836	143.719
141	167.945	144.828
142	169.054	145.937
143	170.163	147.046
144	171.272	148.155
145	172.381	149.264
146	173.490	150.374
147	174.599	151.483
148	175.709	152.592
149	176.818	153.701
150	177.927	154.810
151	179.036	155.919
152	180.145	157.028
153	181.254	158.137
154	182.363	159.247
155	183.472	160.356
156	184.582	161.465
157	185.691	162.574
158	186.800	163.683
159	187.909	164.792
160	188.551	165.901
161	188.551	167.010
162	188.551	168.119
163	188.551	169.229
164	188.551	170.338
165	188.551	171.447
166	188.551	172.556
167	188.551	173.665
168	188.551	174.774
169	188.551	175.883
170	188.551	176.992

TEST II-3

K,SHAPE = .5400 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .100 INPUT BETA= .100
E(N) = 78.78141 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	12.287	0.000	46	62.393	40.046
2	13.401	0.000	47	63.507	41.159
3	14.514	0.000	48	64.620	42.273
4	15.628	0.000	49	65.734	43.386
5	16.741	0.000	50	66.847	44.499
6	17.855	0.000	51	67.961	45.613
7	18.968	0.000	52	69.074	46.726
8	20.082	0.000	53	70.188	47.840
9	21.195	0.000	54	71.301	48.953
10	22.309	0.000	55	72.415	50.067
11	23.422	1.074	56	73.528	51.180
12	24.536	2.188	57	74.642	52.294
13	25.649	3.301	58	75.755	53.407
14	26.762	4.415	59	76.868	54.521
15	27.876	5.528	60	77.982	55.634
16	28.989	6.642	61	79.095	56.748
17	30.103	7.755	62	80.209	57.861
18	31.216	8.869	63	81.322	58.975
19	32.330	9.982	64	82.436	60.088
20	33.443	11.095	65	83.549	61.201
21	34.557	12.209	66	84.663	62.315
22	35.670	13.322	67	85.776	63.428
23	36.784	14.436	68	86.890	64.542
24	37.897	15.549	69	88.003	65.655
25	39.011	16.663	70	89.117	66.769
26	40.124	17.776	71	90.230	67.882
27	41.238	18.890	72	91.344	68.995
28	42.351	20.003	73	92.457	70.109
29	43.464	21.117	74	93.570	71.223
30	44.578	22.230	75	94.684	72.336
31	45.691	23.344	76	95.797	73.450
32	46.805	24.457	77	96.911	74.563
33	47.918	25.571	78	98.024	75.677
34	49.032	26.684	79	99.138	76.790
35	50.145	27.797	80	100.251	77.903
36	51.259	28.911	81	101.365	79.017
37	52.372	30.024	82	102.478	80.130
38	53.486	31.138	83	103.592	81.244
39	54.599	32.251	84	104.705	82.357
40	55.713	33.365	85	105.819	83.471
41	56.826	34.478	86	106.932	84.584
42	57.940	35.592	87	108.046	85.698
43	59.053	36.705	88	109.159	86.811
44	60.166	37.819	89	110.272	87.925
45	61.280	38.932	90	111.386	89.038

TEST	ACCEPT	REJECT
91	112.499	90.152
92	113.613	91.266
93	114.726	92.379
94	115.840	93.492
95	116.953	94.606
96	118.067	95.719
97	119.180	96.832
98	120.294	97.946
99	121.407	99.059
100	122.521	100.173
101	123.634	101.286
102	124.748	102.400
103	125.861	103.513
104	126.975	104.627
105	128.088	105.740
106	129.201	106.854
107	130.315	107.967
108	131.428	109.081
109	132.542	110.194
110	133.655	111.308
111	134.769	112.421
112	135.882	113.534
113	136.996	114.648
114	138.109	115.761
115	139.223	116.875
116	140.336	117.988
117	141.450	119.102
118	142.563	120.215
119	143.677	121.329
120	144.790	122.442
121	145.903	123.556
122	147.017	124.669
123	148.130	125.783
124	149.244	126.896
125	150.357	128.010
126	151.471	129.123
127	152.584	130.236
128	153.698	131.350
129	154.811	132.463
130	155.925	133.577
131	157.038	134.690
132	158.152	135.804
133	159.265	136.917
134	160.379	138.031
135	161.492	139.144
136	162.605	140.258
137	163.719	141.371
138	164.832	142.485
139	165.946	143.598
140	167.059	144.712
141	168.173	145.825
142	169.286	146.938
143	170.400	148.052
144	171.513	149.165
145	172.627	150.279
146	173.740	151.392
147	174.854	152.506
148	175.928	153.619
149	175.928	154.733
150	175.928	155.846
151	175.928	156.960
152	175.928	158.073
153	175.928	159.187
154	175.928	160.300
155	175.928	161.414
156	175.928	162.527
157	175.928	163.640
158	175.928	164.754

TEST II-4

K,SHAPE = .5600 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .100 INPUT BETA= .100
E(N) = 73.44557 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	11.935	0.000	46	62.237	40.603
2	13.053	0.000	47	63.355	41.721
3	14.170	0.000	48	64.472	42.839
4	15.288	0.000	49	65.590	43.956
5	16.406	0.000	50	66.708	45.074
6	17.524	0.000	51	67.826	46.192
7	18.642	0.000	52	68.944	47.310
8	19.760	0.000	53	70.062	48.428
9	20.877	0.000	54	71.179	49.545
10	21.995	.361	55	72.297	50.663
11	23.113	1.479	56	73.415	51.781
12	24.231	2.597	57	74.533	52.899
13	25.349	3.715	58	75.651	54.017
14	26.466	4.833	59	76.769	55.135
15	27.584	5.950	60	77.886	56.252
16	28.702	7.068	61	79.004	57.370
17	29.820	8.186	62	80.122	58.488
18	30.938	9.304	63	81.240	59.606
19	32.056	10.422	64	82.358	60.724
20	33.173	11.539	65	83.475	61.842
21	34.291	12.657	66	84.593	62.959
22	35.409	13.775	67	85.711	64.077
23	36.527	14.893	68	86.829	65.195
24	37.645	16.011	69	87.947	66.313
25	38.763	17.129	70	89.065	67.431
26	39.880	18.246	71	90.182	68.548
27	40.998	19.364	72	91.300	69.666
28	42.116	20.482	73	92.418	70.784
29	43.234	21.600	74	93.536	71.902
30	44.352	22.718	75	94.654	73.020
31	45.469	23.836	76	95.772	74.138
32	46.587	24.953	77	96.889	75.255
33	47.705	26.071	78	98.007	76.373
34	48.823	27.189	79	99.125	77.491
35	49.941	28.307	80	100.243	78.609
36	51.059	29.425	81	101.361	79.727
37	52.176	30.542	82	102.478	80.845
38	53.294	31.660	83	103.596	81.962
39	54.412	32.778	84	104.714	83.080
40	55.530	33.896	85	105.832	84.198
41	56.648	35.014	86	106.950	85.316
42	57.766	36.132	87	108.068	86.434
43	58.883	37.249	88	109.185	87.551
44	60.001	38.367	89	110.303	88.669
45	61.119	39.485	90	111.421	89.787

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
91	112.539	90.905	136	162.841	141.207
92	113.657	92.023	137	163.959	142.325
93	114.775	93.141	138	164.320	143.443
94	115.892	94.258	139	164.320	144.560
95	117.010	95.376	140	164.320	145.678
96	118.128	96.494	141	164.320	146.796
97	119.246	97.612	142	164.320	147.914
98	120.364	98.730	143	164.320	149.032
99	121.481	99.847	144	164.320	150.150
100	122.599	100.965	145	164.320	151.267
101	123.717	102.083	146	164.320	152.385
102	124.835	103.201	147	164.320	153.503
103	125.953	104.319			
104	127.071	105.437			
105	128.188	106.554			
106	129.306	107.672			
107	130.424	108.790			
108	131.542	109.908			
109	132.660	111.026			
110	133.777	112.144			
111	134.895	113.261			
112	136.013	114.379			
113	137.131	115.497			
114	138.249	116.615			
115	139.367	117.733			
116	140.484	118.850			
117	141.602	119.968			
118	142.720	121.086			
119	143.838	122.204			
120	144.956	123.322			
121	146.074	124.440			
122	147.191	125.557			
123	148.309	126.675			
124	149.427	127.793			
125	150.545	128.911			
126	151.663	130.029			
127	152.780	131.147			
128	153.898	132.264			
129	155.016	133.382			
130	156.134	134.500			
131	157.252	135.618			
132	158.370	136.736			
133	159.487	137.853			
134	160.605	138.971			
135	161.723	140.089			

TEST II-5

K,SHAPE = .5800 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .100 INPUT BETA= .100
E(N) = 68.64607 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	11.607	0.000	46	62.105	41.135
2	12.729	0.000	47	63.228	42.258
3	13.851	0.000	48	64.350	43.380
4	14.974	0.000	49	65.472	44.503
5	16.096	0.000	50	66.594	45.625
6	17.218	0.000	51	67.716	46.747
7	18.340	0.000	52	68.839	47.869
8	19.462	0.000	53	69.961	48.991
9	20.584	0.000	54	71.083	50.113
10	21.707	.737	55	72.205	51.236
11	22.829	1.859	56	73.327	52.358
12	23.951	2.981	57	74.450	53.480
13	25.073	4.104	58	75.572	54.602
14	26.195	5.226	59	76.694	55.724
15	27.318	6.348	60	77.816	56.847
16	28.440	7.470	61	78.938	57.969
17	29.562	8.592	62	80.061	59.091
18	30.684	9.715	63	81.183	60.213
19	31.806	10.837	64	82.305	61.335
20	32.929	11.959	65	83.427	62.458
21	34.051	13.081	66	84.549	63.580
22	35.173	14.203	67	85.671	64.702
23	36.295	15.326	68	86.794	65.824
24	37.417	16.448	69	87.916	66.946
25	38.540	17.570	70	89.038	68.068
26	39.662	18.692	71	90.160	69.191
27	40.784	19.814	72	91.282	70.313
28	41.906	20.937	73	92.405	71.435
29	43.028	22.059	74	93.527	72.557
30	44.150	23.181	75	94.649	73.679
31	45.273	24.303	76	95.771	74.802
32	46.395	25.425	77	96.893	75.924
33	47.517	26.547	78	98.016	77.046
34	48.639	27.670	79	99.138	78.168
35	49.761	28.792	80	100.260	79.290
36	50.884	29.914	81	101.382	80.413
37	52.006	31.036	82	102.504	81.535
38	53.128	32.158	83	103.626	82.657
39	54.250	33.281	84	104.749	83.779
40	55.372	34.403	85	105.871	84.901
41	56.495	35.525	86	106.993	86.024
42	57.617	36.647	87	108.115	87.146
43	58.739	37.769	88	109.237	88.268
44	59.861	38.892	89	110.360	89.390
45	60.983	40.014	90	111.482	90.512

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
91	112.604	91.634	136	154.862	142.133
92	113.726	92.757	137	154.862	143.255
93	114.848	93.879	138	154.862	144.377
94	115.971	95.001			
95	117.093	96.123			
96	118.215	97.245			
97	119.337	98.368			
98	120.459	99.490			
99	121.582	100.612			
100	122.704	101.734			
101	123.826	102.856			
102	124.948	103.979			
103	126.070	105.101			
104	127.192	106.223			
105	128.315	107.345			
106	129.437	108.467			
107	130.559	109.589			
108	131.681	110.712			
109	132.803	111.834			
110	133.926	112.956			
111	135.048	114.078			
112	136.170	115.200			
113	137.292	116.323			
114	138.414	117.445			
115	139.537	118.567			
116	140.659	119.689			
117	141.731	120.811			
118	142.903	121.934			
119	144.025	123.056			
120	145.147	124.178			
121	146.270	125.300			
122	147.392	126.422			
123	148.514	127.545			
124	149.636	128.667			
125	150.758	129.789			
126	151.881	130.911			
127	153.003	132.033			
128	154.125	133.155			
129	154.862	134.[illegible]8			
130	154.862	135.4[illegible]0			
131	154.862	136.522			
132	154.862	137.644			
133	154.862	138.766			
134	154.862	139.889			
135	154.862	141.011			

TEST II-6

K,SHAPE = .6000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .100 INPUT BETA= .100
E(N) = 64.31275 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	11.301	0.000	46	61.997	41.647
2	12.428	0.000	47	63.123	42.774
3	13.555	0.000	48	64.250	43.900
4	14.681	0.000	49	65.377	45.027
5	15.808	0.000	50	66.503	46.154
6	16.934	0.000	51	67.630	47.280
7	18.061	0.000	52	68.756	48.407
8	19.187	0.000	53	69.883	49.533
9	20.314	0.000	54	71.009	50.660
10	21.440	1.091	55	72.136	51.786
11	22.567	2.217	56	73.263	52.913
12	23.694	3.344	57	74.389	54.039
13	24.820	4.471	58	75.516	55.166
14	25.947	5.597	59	76.642	56.293
15	27.073	6.724	60	77.769	57.419
16	28.200	7.850	61	78.895	58.546
17	29.325	8.977	62	80.022	59.672
18	30.453	10.103	63	81.149	60.799
19	31.580	11.230	64	82.275	61.925
20	32.706	12.357	65	83.402	63.052
21	33.833	13.483	66	84.528	64.179
22	34.959	14.610	67	85.655	65.305
23	36.086	15.736	68	86.781	66.432
24	37.212	16.853	69	87.908	67.558
25	38.339	17.989	70	89.034	68.685
26	39.466	19.116	71	90.161	69.811
27	40.592	20.242	72	91.288	70.938
28	41.719	21.369	73	92.414	72.065
29	42.845	22.496	74	93.541	73.191
30	43.972	23.622	75	94.667	74.318
31	45.098	24.749	76	95.794	75.444
32	46.225	25.875	77	96.920	76.571
33	47.352	27.002	78	98.047	77.697
34	48.478	28.128	79	99.174	78.824
35	49.605	29.255	80	100.300	79.951
36	50.731	30.382	81	101.427	81.077
37	51.858	31.508	82	102.553	82.204
38	52.984	32.635	83	103.680	83.330
39	54.111	33.761	84	104.806	84.457
40	55.237	34.888	85	105.933	85.583
41	56.364	36.014	86	107.060	86.710
42	57.491	37.141	87	108.186	87.836
43	58.617	38.268	88	109.313	88.963
44	59.744	39.394	89	110.439	90.090
45	60.870	40.521	90	111.566	91.216

TEST	ACCEPT	REJECT
91	112.592	92.343
92	113.819	93.459
93	114.945	94.596
94	116.072	95.722
95	117.199	95.849
96	118.325	97.976
97	119.452	99.102
98	120.578	100.229
99	121.705	101.355
100	122.831	102.482
101	123.958	103.608
102	125.085	104.735
103	126.211	105.852
104	127.338	106.988
105	128.464	108.115
106	129.591	109.241
107	130.717	110.368
108	131.844	111.494
109	132.971	112.621
110	134.097	113.748
111	135.224	114.874
112	136.350	116.001
113	137.477	117.127
114	138.603	118.254
115	139.730	119.380
116	140.857	120.507
117	141.983	121.633
118	143.110	122.760
119	144.236	123.887
120	145.327	125.013
121	145.327	126.140
122	145.327	127.266
123	145.327	128.393
124	145.327	129.519
125	145.327	130.646
126	145.327	131.773
127	145.327	132.899
128	145.327	134.026
129	145.327	135.152

TEST II-7

K,SHAPE = .6250   DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .100   INPUT BETA= .100
E(N) = 59.46306   E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	10.947	0.000	46	61.890	42.259
2	12.080	0.000	47	63.022	43.391
3	13.212	0.000	48	64.154	44.523
4	14.344	0.000	49	65.286	45.655
5	15.475	0.000	50	66.418	46.787
6	16.608	0.000	51	67.550	47.919
7	17.740	0.000	52	68.682	49.051
8	18.872	0.000	53	69.814	50.183
9	20.004	.373	54	70.946	51.315
10	21.136	1.505	55	72.078	52.448
11	22.268	2.637	56	73.210	53.580
12	23.400	3.769	57	74.342	54.712
13	24.532	4.901	58	75.475	55.844
14	25.664	6.033	59	76.607	56.975
15	26.796	7.165	60	77.739	58.108
16	27.928	8.297	61	78.871	59.240
17	29.060	9.430	62	80.003	60.372
18	30.192	10.562	63	81.135	61.504
19	31.324	11.694	64	82.267	62.636
20	32.456	12.826	65	83.399	63.768
21	33.589	13.958	66	84.531	64.900
22	34.721	15.090	67	85.663	66.032
23	35.853	16.222	68	86.795	67.164
24	36.985	17.354	69	87.927	68.296
25	38.117	18.486	70	89.059	69.428
26	39.249	19.618	71	90.191	70.560
27	40.381	20.750	72	91.323	71.692
28	41.513	21.882	73	92.455	72.825
29	42.645	23.014	74	93.587	73.957
30	43.777	24.146	75	94.719	75.089
31	44.909	25.278	76	95.851	76.221
32	46.041	26.410	77	96.984	77.353
33	47.173	27.542	78	98.116	78.485
34	48.305	28.674	79	99.248	79.617
35	49.437	29.806	80	100.380	80.749
36	50.569	30.939	81	101.512	81.881
37	51.701	32.071	82	102.644	83.013
38	52.833	33.203	83	103.776	84.145
39	53.965	34.335	84	104.908	85.277
40	55.098	35.467	85	106.040	86.409
41	56.230	36.599	86	107.172	87.541
42	57.362	37.731	87	108.304	88.673
43	58.494	38.863	88	109.436	89.805
44	59.626	39.995	89	110.568	90.937
45	60.758	41.127	90	111.700	92.069

TEST	ACCEPT	REJECT
91	112.832	93.201
92	113.964	94.334
93	115.096	95.466
94	116.228	96.598
95	117.361	97.730
96	118.493	98.852
97	119.625	99.994
98	120.757	101.126
99	121.889	102.258
100	123.021	103.390
101	124.153	104.522
102	125.285	105.654
103	126.417	106.786
104	127.549	107.918
105	128.681	109.050
106	129.813	110.182
107	130.945	111.314
108	132.077	112.446
109	133.209	113.578
110	134.341	114.711
111	134.714	115.843
112	134.714	116.975
113	134.714	118.107
114	134.714	119.239
115	134.714	120.371
116	134.714	121.503
117	134.714	122.635
118	134.714	123.757
119	134.714	124.899

TEST II-8

K,SHAPE = .6500 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .100 INPUT BETA= .100
E(N) = 55.15512 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	10.621	0.000	46	61.811	42.844
2	11.759	0.000	47	62.949	43.981
3	12.896	0.000	48	64.087	45.119
4	14.034	0.000	49	65.224	46.257
5	15.172	0.000	50	66.362	47.394
6	16.309	0.000	51	67.499	48.532
7	17.447	0.000	52	68.637	49.669
8	18.584	0.000	53	69.774	50.807
9	19.722	.754	54	70.912	51.944
10	20.859	1.892	55	72.049	53.082
11	21.997	3.029	56	73.187	54.219
12	23.134	4.167	57	74.325	55.357
13	24.272	5.304	58	75.462	56.495
14	25.410	6.442	59	76.600	57.632
15	26.547	7.580	60	77.737	58.770
16	27.685	8.717	61	78.875	59.907
17	28.822	9.855	62	80.012	61.045
18	29.960	10.992	63	81.150	62.182
19	31.097	12.130	64	82.287	63.320
20	32.235	13.267	65	83.425	64.457
21	33.372	14.405	66	84.563	65.595
22	34.510	15.543	67	85.700	66.733
23	35.648	16.680	68	86.838	67.870
24	36.785	17.818	69	87.975	69.008
25	37.923	18.955	70	89.113	70.145
26	39.060	20.093	71	90.250	71.283
27	40.198	21.230	72	91.388	72.420
28	41.335	22.368	73	92.525	73.558
29	42.473	23.505	74	93.663	74.696
30	43.611	24.643	75	94.801	75.833
31	44.748	25.781	76	95.938	76.971
32	45.886	26.918	77	97.076	78.108
33	47.023	28.056	78	98.213	79.246
34	48.161	29.193	79	99.351	80.383
35	49.298	30.331	80	100.488	81.521
36	50.436	31.468	81	101.626	82.658
37	51.573	32.606	82	102.764	83.796
38	52.711	33.743	83	103.901	84.934
39	53.849	34.881	84	105.039	86.071
40	54.986	36.019	85	106.176	87.209
41	56.124	37.156	86	107.314	88.346
42	57.261	38.294	87	108.451	89.484
43	58.399	39.431	88	109.589	90.621
44	59.536	40.569	89	110.726	91.759
45	60.674	41.706	90	111.864	92.896

TEST	ACCEPT	REJECT
91	113.002	94.034
92	114.139	95.172
93	115.277	96.309
94	116.414	97.447
95	117.552	98.584
96	118.689	99.722
97	119.827	100.859
98	120.964	101.997
99	122.102	103.134
100	123.240	104.272
101	124.377	105.410
102	125.515	106.547
103	126.269	107.685
104	126.269	108.822
105	126.269	109.960
106	126.269	111.097
107	126.269	112.235
108	126.269	113.372
109	126.269	114.510
110	126.269	115.648
111	126.269	116.785

TEST II-9

K,SHAPE = .6750 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .100 INPUT BETA= .100
E(N) = 51.31070 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	10.320	0.000	46	61.758	43.405
2	11.463	0.000	47	62.902	44.548
3	12.606	0.000	48	64.045	45.691
4	13.749	0.000	49	65.188	46.834
5	14.892	0.000	50	66.331	47.977
6	16.035	0.000	51	67.474	49.120
7	17.178	0.000	52	68.617	50.263
8	18.321	0.000	53	69.760	51.406
9	19.465	1.111	54	70.903	52.549
10	20.608	2.254	55	72.046	53.692
11	21.751	3.397	56	73.189	54.836
12	22.894	4.540	57	74.332	55.979
13	24.037	5.683	58	75.475	57.122
14	25.180	6.826	59	76.618	58.265
15	26.323	7.969	60	77.762	59.408
16	27.466	9.112	61	78.905	60.551
17	28.609	10.255	62	80.048	61.694
18	29.752	11.399	63	81.191	62.837
19	30.895	12.542	64	82.334	63.980
20	32.038	13.685	65	83.477	65.123
21	33.181	14.828	66	84.620	66.266
22	34.325	15.971	67	85.763	67.409
23	35.468	17.114	68	86.906	68.553
24	36.611	18.257	69	88.049	69.696
25	37.754	19.400	70	89.192	70.839
26	38.897	20.543	71	90.335	71.982
27	40.040	21.686	72	91.479	73.125
28	41.183	22.829	73	92.622	74.268
29	42.326	23.972	74	93.765	75.411
30	43.469	25.116	75	94.908	76.554
31	44.612	26.259	76	96.051	77.697
32	45.755	27.402	77	97.194	78.840
33	46.898	28.545	78	98.337	79.983
34	48.042	29.688	79	99.480	81.126
35	49.185	30.831	80	100.623	82.269
36	50.328	31.974	81	101.766	83.413
37	51.471	33.117	82	102.909	84.556
38	52.614	34.260	83	104.052	85.699
39	53.757	35.403	84	105.195	86.842
40	54.900	36.546	85	106.339	87.985
41	56.043	37.689	86	107.482	89.128
42	57.186	38.832	87	108.625	90.271
43	58.329	39.976	88	109.768	91.414
44	59.472	41.119	89	110.911	92.557
45	60.615	42.262	90	112.054	93.700

TEST	ACCEPT	REJECT
91	113.197	94.843
92	114.340	95.986
93	115.483	97.129
94	116.626	98.273
95	117.737	99.416
96	117.737	100.559
97	117.737	101.702
98	117.737	102.845
99	117.737	103.988
100	117.737	105.131
101	117.737	106.274
102	117.737	107.417
103	117.737	108.560

TEST II-10

K,SHAPE = .7000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .100 INPUT BETA= .100
E(N) = 47.86521 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	10.041	0.000	46	61.728	43.944
2	11.189	0.000	47	62.877	45.093
3	12.338	0.000	48	64.026	46.242
4	13.486	0.000	49	65.174	47.390
5	14.635	0.000	50	66.323	48.539
6	15.784	0.000	51	67.471	49.687
7	16.932	0.000	52	68.620	50.836
8	18.081	.297	53	69.769	51.985
9	19.230	1.446	54	70.917	53.133
10	20.378	2.594	55	72.066	54.282
11	21.527	3.743	56	73.215	55.431
12	22.675	4.891	57	74.363	56.579
13	23.824	6.040	58	75.512	57.728
14	24.973	7.189	59	76.660	58.876
15	26.121	8.337	60	77.809	60.025
16	27.270	9.486	61	78.958	61.174
17	28.418	10.635	62	80.106	62.322
18	29.567	11.783	63	81.255	63.471
19	30.716	12.932	64	82.403	64.620
20	31.864	14.080	65	83.552	65.768
21	33.013	15.229	66	84.701	66.917
22	34.162	16.378	67	85.849	68.065
23	35.310	17.526	68	86.998	69.214
24	36.459	18.675	69	88.147	70.363
25	37.607	19.823	70	89.295	71.511
26	38.756	20.972	71	90.444	72.660
27	39.905	22.121	72	91.592	73.808
28	41.053	23.269	73	92.741	74.957
29	42.202	24.418	74	93.890	76.106
30	43.350	25.567	75	95.038	77.254
31	44.499	26.715	76	96.187	78.403
32	45.648	27.864	77	97.335	79.552
33	46.796	29.012	78	98.484	80.700
34	47.945	30.161	79	99.633	81.849
35	49.094	31.310	80	100.781	82.997
36	50.242	32.458	81	101.930	84.146
37	51.391	33.607	82	103.079	85.295
38	52.539	34.755	83	104.227	86.443
39	53.688	35.904	84	105.376	87.592
40	54.837	37.053	85	106.524	88.740
41	55.985	38.201	86	107.673	89.889
42	57.134	39.350	87	108.822	91.038
43	58.282	40.499	88	109.970	92.186
44	59.431	41.647	89	110.267	93.335
45	60.580	42.796	90	110.267	94.484

TEST	ACCEPT	REJECT
91	110.267	95.632
92	110.267	96.781
93	110.267	97.929
94	110.267	99.078
95	110.267	100.227
96	110.267	101.375

TEST II-11

K,SHAPE = .7250 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .100 INPUT BETA= .100
E(N) = 44.76496 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	9.781	0.000	46	61.719	44.465
2	10.935	0.000	47	62.873	45.619
3	12.089	0.000	48	64.027	46.773
4	13.244	0.000	49	65.181	47.928
5	14.398	0.000	50	66.335	49.082
6	15.552	0.000	51	67.490	50.236
7	16.706	0.000	52	68.644	51.390
8	17.860	.607	53	69.798	52.544
9	19.014	1.761	54	70.952	53.698
10	20.169	2.915	55	72.106	54.853
11	21.323	4.069	56	73.261	56.007
12	22.477	5.223	57	74.415	57.161
13	23.631	6.377	58	75.569	58.315
14	24.785	7.532	59	76.723	59.469
15	25.939	8.686	60	77.877	60.623
16	27.094	9.840	61	79.031	61.778
17	28.248	10.994	62	80.185	62.932
18	29.402	12.148	63	81.340	64.086
19	30.556	13.302	64	82.494	65.240
20	31.710	14.457	65	83.648	66.394
21	32.864	15.611	66	84.802	67.548
22	34.019	16.765	67	85.956	68.703
23	35.173	17.919	68	87.111	69.857
24	36.327	19.073	69	88.265	71.011
25	37.481	20.227	70	89.419	72.165
26	38.635	21.382	71	90.573	73.319
27	39.790	22.536	72	91.727	74.474
28	40.944	23.690	73	92.881	75.628
29	42.098	24.844	74	94.036	76.782
30	43.252	25.998	75	95.190	77.936
31	44.406	27.152	76	96.344	79.090
32	45.560	28.307	77	97.498	80.244
33	46.715	29.461	78	98.652	81.399
34	47.869	30.615	79	99.806	82.553
35	49.023	31.769	80	100.961	83.707
36	50.177	32.923	81	102.115	84.861
37	51.331	34.077	82	103.269	86.015
38	52.485	35.232	83	103.875	87.169
39	53.640	36.386	84	103.875	88.324
40	54.794	37.540	85	103.875	89.478
41	55.948	38.694	86	103.875	90.632
42	57.102	39.848	87	103.875	91.786
43	58.256	41.003	88	103.875	92.940
44	59.410	42.157	89	103.875	94.094
45	60.565	43.311	90	103.875	95.249

TEST II-12

K,SHAPE = .7500 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .100 INPUT BETA= .100
E(N) = 41.36502 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	9.539	0.000	46	61.728	44.969
2	10.699	0.000	47	62.888	46.128
3	11.859	0.000	48	64.047	47.288
4	13.019	0.000	49	65.207	48.448
5	14.178	0.000	50	66.367	49.608
6	15.338	0.000	51	67.527	50.767
7	16.498	0.000	52	68.686	51.927
8	17.658	.898	53	69.846	53.087
9	18.817	2.058	54	71.006	54.247
10	19.977	3.218	55	72.165	55.405
11	21.137	4.378	56	73.325	56.566
12	22.296	5.537	57	74.485	57.725
13	23.456	6.697	58	75.645	58.885
14	24.616	7.857	59	76.804	60.045
15	25.776	9.017	60	77.964	61.205
16	26.935	10.176	61	79.124	62.365
17	28.095	11.336	62	80.284	63.525
18	29.255	12.496	63	81.443	64.684
19	30.415	13.656	64	82.603	65.844
20	31.574	14.815	65	83.763	67.004
21	32.734	15.975	66	84.923	68.164
22	33.894	17.135	67	86.082	69.323
23	35.054	18.295	68	87.242	70.483
24	36.213	19.454	69	88.402	71.643
25	37.373	20.614	70	89.562	72.803
26	38.533	21.774	71	90.721	73.962
27	39.693	22.934	72	91.881	75.122
28	40.852	24.093	73	93.041	76.282
29	42.012	25.253	74	94.201	77.441
30	43.172	26.413	75	95.360	78.601
31	44.332	27.572	76	96.520	79.761
32	45.491	28.732	77	97.418	80.921
33	46.651	29.892	78	97.418	82.080
34	47.811	31.052	79	97.418	83.240
35	48.971	32.211	80	97.418	84.400
36	50.130	33.371	81	97.418	85.560
37	51.290	34.531	82	97.418	86.719
38	52.450	35.691	83	97.418	87.879
39	53.610	36.850	84	97.418	89.039
40	54.769	38.010			
41	55.929	39.170			
42	57.089	40.330			
43	58.249	41.489			
44	59.408	42.649			
45	60.568	43.809			

TEST II-13

K,SHAPE = .8000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .100 INPUT BETA= .100
E(N) = 37.12056 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	9.103	0.000	46	61.795	45.932
2	10.274	0.000	47	62.966	47.102
3	11.444	0.000	48	64.137	48.273
4	12.615	0.000	49	65.308	49.444
5	13.786	0.000	50	66.479	50.615
6	14.957	0.000	51	67.650	51.786
7	16.128	.255	52	68.820	52.957
8	17.299	1.436	53	69.991	54.128
9	18.470	2.607	54	71.162	55.299
10	19.641	3.778	55	72.333	56.470
11	20.812	4.949	56	73.504	57.641
12	21.983	6.120	57	74.675	58.812
13	23.154	7.291	58	75.846	59.983
14	24.325	8.461	59	77.017	61.154
15	25.495	9.632	60	78.188	62.325
16	26.667	10.803	61	79.359	63.496
17	27.838	11.974	62	80.530	64.667
18	29.009	13.145	63	81.701	65.837
19	30.180	14.316	64	82.872	67.008
20	31.350	15.487	65	84.043	68.179
21	32.521	16.658	66	85.214	69.350
22	33.692	17.829	67	86.385	70.521
23	34.863	19.000	68	87.556	71.692
24	36.034	20.171	69	87.820	72.863
25	37.205	21.342	70	87.820	74.034
26	38.376	22.513	71	87.820	75.205
27	39.547	23.684	72	87.820	76.376
28	40.718	24.855	73	87.820	77.547
29	41.889	26.026	74	87.820	78.718
30	43.060	27.196	75	87.820	79.889
31	44.231	28.367			
32	45.402	29.538			
33	46.573	30.709			
34	47.744	31.880			
35	48.915	33.051			
36	50.085	34.222			
37	51.256	35.393			
38	52.427	36.564			
39	53.598	37.735			
40	54.769	38.906			
41	55.940	40.077			
42	57.111	41.248			
43	58.282	42.419			
44	59.453	43.590			
45	60.624	44.761			

TEST II-14

K,SHAPE = .8500 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .100 INPUT BETA= .100
E(N) = 37.09265 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	8.719	0.000	46	61.918	46.844
2	9.901	0.000	47	63.100	48.027
3	11.084	0.000	48	64.283	49.209
4	12.266	0.000	49	65.465	50.391
5	13.448	0.000	50	66.647	51.573
6	14.630	0.000	51	67.829	52.755
7	15.812	.738	52	69.011	53.938
8	16.995	1.921	53	70.194	55.120
9	18.177	3.103	54	71.376	56.302
10	19.359	4.285	55	72.558	57.484
11	20.541	5.467	56	73.740	58.666
12	21.723	6.650	57	74.922	59.849
13	22.906	7.832	58	76.105	61.031
14	24.088	9.014	59	77.287	62.213
15	25.270	10.196	60	78.469	63.395
16	26.452	11.378	61	79.208	64.577
17	27.634	12.561	62	79.208	65.760
18	28.817	13.743	63	79.208	66.942
19	29.999	14.925	64	79.208	68.124
20	31.181	16.107	65	79.208	69.306
21	32.363	17.289	66	79.208	70.488
22	33.545	18.472	67	79.208	71.671
23	34.728	19.654			
24	35.910	20.836			
25	37.092	22.018			
26	38.274	23.200			
27	39.456	24.383			
28	40.639	25.565			
29	41.821	26.747			
30	43.003	27.929			
31	44.185	29.111			
32	45.367	30.294			
33	46.550	31.476			
34	47.732	32.658			
35	48.914	33.840			
36	50.096	35.022			
37	51.278	36.205			
38	52.461	37.387			
39	53.643	38.569			
40	54.825	39.751			
41	56.007	40.933			
42	57.189	42.116			
43	58.372	43.298			
44	59.554	44.480			
45	60.736	45.652			

TEST II-15

K,SHAPE = .9000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .100 INPUT BETA= .100
E(N) = 29.70539 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	8.380	0.000	46	62.089	47.716
2	9.573	0.000	47	63.282	48.910
3	10.767	0.000	48	64.476	50.103
4	11.961	0.000	49	65.669	51.297
5	13.154	0.000	50	66.863	52.490
6	14.348	0.000	51	68.057	53.684
7	15.541	1.168	52	69.250	54.877
8	16.735	2.362	53	70.444	56.071
9	17.929	3.555	54	71.612	57.264
10	19.122	4.749	55	71.612	58.458
11	20.315	5.942	56	71.612	59.651
12	21.509	7.136	57	71.612	60.845
13	22.702	8.329	58	71.612	62.039
14	23.896	9.523	59	71.612	63.232
15	25.089	10.717	60	71.612	64.425
16	26.283	11.910			
17	27.476	13.104			
18	28.670	14.297			
19	29.864	15.491			
20	31.057	16.684			
21	32.251	17.878			
22	33.444	19.071			
23	34.638	20.265			
24	35.831	21.458			
25	37.025	22.652			
26	38.218	23.845			
27	39.412	25.039			
28	40.605	26.232			
29	41.799	27.426			
30	42.992	28.620			
31	44.186	29.813			
32	45.379	31.007			
33	46.573	32.200			
34	47.767	33.394			
35	48.960	34.587			
36	50.154	35.781			
37	51.347	36.974			
38	52.541	38.158			
39	53.734	39.361			
40	54.928	40.555			
41	56.121	41.748			
42	57.315	42.942			
43	58.508	44.135			
44	59.702	45.329			
45	60.895	46.523			

TEST II-16

K,SHAPE = .9500 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .100 INPUT BETA= .100
E(N) = 26.83143 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	8.078	0.000	46	62.300	48.554
2	9.283	0.000	47	63.505	49.759
3	10.488	0.000	48	64.710	50.963
4	11.693	0.000	49	65.066	52.168
5	12.898	0.000	50	65.065	53.373
6	14.103	.356	51	65.066	54.578
7	15.308	1.551	52	65.066	55.783
8	16.513	2.766	53	65.066	56.988
9	17.718	3.971	54	65.066	58.193
10	18.923	5.176			
11	20.127	6.381			
12	21.332	7.586			
13	22.537	8.791			
14	23.742	9.996			
15	24.947	11.201			
16	26.152	12.406			
17	27.357	13.611			
18	28.562	14.816			
19	29.767	15.020			
20	30.972	17.225			
21	32.177	18.430			
22	33.382	19.635			
23	34.587	20.840			
24	35.792	22.045			
25	36.996	23.250			
26	38.201	24.455			
27	39.406	25.650			
28	40.611	26.855			
29	41.816	28.070			
30	43.021	29.275			
31	44.226	30.480			
32	45.431	31.685			
33	46.636	32.889			
34	47.841	34.094			
35	49.046	35.299			
36	50.251	36.504			
37	51.456	37.709			
38	52.661	38.914			
39	53.865	40.119			
40	55.070	41.324			
41	56.275	42.529			
42	57.480	43.734			
43	58.685	44.939			
44	59.890	46.144			
45	61.095	47.349			

TEST II-17

K,SHAPE =1.0000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .100 INPUT BETA= .100
E(N) = 24.35901 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	7.808	0.000
2	9.024	0.000
3	10.241	0.000
4	11.457	0.000
5	12.674	0.000
6	13.890	.707
7	15.106	1.923
8	16.323	3.139
9	17.539	4.356
10	18.756	5.572
11	19.972	6.789
12	21.188	8.005
13	22.405	9.221
14	23.621	10.438
15	24.838	11.654
16	26.054	12.871
17	27.270	14.087
18	28.487	15.303
19	29.703	16.520
20	30.920	17.736
21	32.136	18.953
22	33.352	20.159
23	34.569	21.385
24	35.785	22.502
25	37.002	23.818
26	38.218	25.035
27	39.434	26.251
28	40.651	27.467
29	41.867	28.684
30	43.084	29.900
31	44.300	31.117
32	45.516	32.333
33	46.733	33.549
34	47.949	34.766
35	49.166	35.982
36	50.382	37.199
37	51.598	38.415
38	52.815	39.631
39	54.031	40.848
40	55.247	42.064
41	56.464	43.281
42	57.680	44.497
43	58.897	45.713
44	59.603	46.930
45	59.603	48.146
46	59.603	49.363
47	59.603	50.579
48	59.603	51.795
49	59.603	53.012

TEST II-18

K,SHAPE =1.1000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .100 INPUT BETA= .100
E(N) = 20.39473 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	7.346	0.000
2	8.585	0.000
3	9.825	0.000
4	11.065	0.000
5	12.304	.091
6	13.544	1.331
7	14.783	2.570
8	16.023	3.810
9	17.262	5.049
10	18.502	6.289
11	19.741	7.528
12	20.981	8.758
13	22.220	10.007
14	23.460	11.247
15	24.699	12.487
16	25.939	13.726
17	27.178	14.966
18	28.418	16.205
19	29.657	17.445
20	30.897	18.684
21	32.136	19.924
22	33.376	21.163
23	34.616	22.403
24	35.855	23.642
25	37.095	24.882
26	38.334	26.121
27	39.574	27.361
28	40.813	28.600
29	42.053	29.840
30	43.292	31.079
31	44.532	32.319
32	45.771	33.559
33	47.011	34.798
34	48.250	36.038
35	49.490	37.277
36	50.729	38.517
37	50.821	39.756
38	50.821	40.996
39	50.821	42.235
40	50.821	43.475
41	50.821	44.714

TEST II-19

K,SHAPE =1.2000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .100 INPUT BETA= .100
E(N) = 17.35278 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	6.966	0.000
2	8.229	0.000
3	9.492	0.000
4	10.755	0.000
5	12.018	.611
6	13.281	1.874
7	14.544	3.137
8	15.807	4.400
9	17.070	5.663
10	18.333	6.926
11	19.595	8.189
12	20.858	9.452
13	22.121	10.715
14	23.384	11.978
15	24.647	13.241
16	25.910	14.504
17	27.173	15.767
18	28.436	17.030
19	29.699	18.292
20	30.962	19.555
21	32.225	20.818
22	33.488	22.081
23	34.751	23.344
24	36.014	24.607
25	37.276	25.870
26	38.539	27.133
27	39.802	28.396
28	41.065	29.659
29	42.328	30.922
30	43.591	32.185
31	44.203	33.448
32	44.203	34.711
33	44.203	35.973
34	44.203	37.236
35	44.203	38.499

TEST II-20

K,SHAPE =1.3000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .100 INPUT BETA= .100
E(N) = 14.97049 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	6.650	0.000
2	7.936	0.000
3	9.223	0.000
4	10.510	0.000
5	11.796	1.070
6	13.083	2.356
7	14.369	3.543
8	15.656	4.930
9	16.943	6.216
10	18.229	7.503
11	19.516	8.789
12	20.802	10.076
13	22.089	11.363
14	23.376	12.649
15	24.662	13.936
16	25.949	15.222
17	27.235	16.509
18	28.522	17.796
19	29.809	19.082
20	31.095	20.369
21	32.382	21.655
22	33.668	22.942
23	34.955	24.229
24	36.242	25.515
25	37.528	26.802
26	38.598	28.088
27	38.598	29.375
28	38.598	30.662
29	38.598	31.948
30	38.598	33.235

K,SHAPE =1.4000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .100 INPUT BETA= .100
E(N) = 13.06835 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	6.383	0.000
2	7.694	0.000
3	9.004	0.000
4	10.315	.169
5	11.625	1.480
6	12.936	2.790
7	14.246	4.101
8	15.557	5.412
9	16.868	6.722
10	18.178	8.033
11	19.489	9.343
12	20.799	10.654
13	22.110	11.964
14	23.420	13.275
15	24.731	14.585
16	26.041	15.896
17	27.352	17.206
18	28.662	18.517
19	29.973	19.827
20	31.283	21.138
21	32.594	22.449
22	33.904	23.759
23	35.215	25.070
24	35.384	26.380
25	35.384	27.691
26	35.384	29.001
27	35.384	30.312

TEST II-22

K,SHAPE =1.5000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .100 INPUT BETA= .100
E(N) = 11.52425 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	6.157	0.000
2	7.491	0.000
3	8.826	0.000
4	10.161	.517
5	11.496	1.852
6	12.830	3.186
7	14.165	4.521
8	15.500	5.856
9	16.835	7.191
10	18.169	8.525
11	19.504	9.860
12	20.839	11.195
13	22.174	12.530
14	23.508	13.864
15	24.843	15.199
16	26.178	16.534
17	27.512	17.869
18	28.847	19.203
19	30.182	20.538
20	31.517	21.873
21	32.034	23.207
22	32.034	24.542
23	32.034	25.877
24	32.034	27.212

TEST II-23

K,SHAPE =1.5000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .100 INPUT BETA= .100
E(N) = 10.25267 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	5.963	0.000
2	7.322	0.000
3	8.681	0.000
4	10.040	.833
5	11.399	2.193
6	12.759	3.552
7	14.118	4.911
8	15.477	6.270
9	16.836	7.629
10	18.195	8.989
11	19.555	10.348
12	20.914	11.707
13	22.273	13.066
14	23.632	14.425
15	24.991	15.785
16	26.351	17.144
17	27.710	18.503
18	28.543	19.862
19	28.543	21.221
20	28.543	22.581
21	28.543	23.940

TEST II-24

K,SHAPE =1.7000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .100 INPUT BETA= .100
E(N) = 9.19232 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	5.795	0.000
2	7.179	0.000
3	8.563	0.000
4	9.947	1.124
5	11.331	2.508
6	12.715	3.892
7	14.099	5.276
8	15.483	6.660
9	16.867	8.044
10	18.251	9.428
11	19.635	10.812
12	21.019	12.196
13	22.403	13.580
14	23.786	14.964
15	25.170	16.347
16	26.295	17.731
17	26.295	19.115
18	26.295	20.499
19	26.295	21.883

TEST II-25

K,SHAPE =1.8000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .100 INPUT BETA= .100
E(N) = 8.29828 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	5.651	0.000
2	7.059	0.000
3	8.468	0.000
4	9.877	1.394
5	11.286	2.803
6	12.695	4.212
7	14.104	5.621
8	15.513	7.030
9	16.922	8.439
10	18.331	9.848
11	19.740	11.256
12	21.149	12.665
13	22.558	14.074
14	23.952	15.483
15	23.952	16.892
16	23.952	18.301
17	23.952	19.710

TEST II-26

K,SHAPE =1.9000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .100 INPUT BETA= .100 NMAX= 10
E(N) = 7.53703 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	5.525	0.000
2	6.959	0.000
3	8.393	.212
4	9.827	1.646
5	11.261	3.080
6	12.695	4.515
7	14.130	5.949
8	15.564	7.383
9	16.998	8.817
10	18.432	10.251
11	19.866	11.685
12	21.300	13.120
13	22.735	14.554
14	22.947	15.988
15	22.947	17.422
16	22.947	18.856

TEST II-27

K,SHAPE =2.0000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .100 INPUT BETA= .100
E(N) = 6.88314 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	5.415	0.000
2	6.874	0.000
3	8.334	.424
4	9.794	1.884
5	11.253	3.343
6	12.713	4.803
7	14.173	6.253
8	15.532	7.722
9	17.092	9.182
10	18.552	10.642
11	20.011	12.101
12	20.435	13.551
13	20.435	15.021
14	20.435	15.480

TEST II-28

K,SHAPE =2.1000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .100 INPUT BETA= .100
E(N) = 6.31702 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	5.319	0.000
2	6.804	0.000
3	8.289	.623
4	9.775	2.109
5	11.260	3.594
6	12.746	5.079
7	14.231	6.555
8	15.717	8.050
9	17.202	9.536
10	18.688	11.021
11	19.311	12.507
12	19.311	13.992
13	19.311	15.478

TEST II-29

K,SHAPE =2.2000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .100 INPUT BETA= .100
E(N) = 5.82337 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	5.234	0.000
2	6.746	0.000
3	8.257	.811
4	9.769	2.323
5	11.280	3.834
6	12.792	5.346
7	14.303	6.857
8	15.815	8.369
9	17.326	9.880
10	18.137	11.392
11	18.137	12.903
12	18.137	14.414

TEST II-30

K,SHAPE =2.3000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .100 INPUT BETA= .100
E(N) = 5.39013 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	5.161	0.000
2	6.698	0.000
3	8.236	.990
4	9.774	2.528
5	11.312	4.066
6	12.849	5.603
7	14.387	7.141
8	15.925	8.679
9	16.915	10.217
10	16.915	11.754
11	16.915	13.292

TEST II-31

K,SHAPE =2.4000   DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .100   INPUT BETA= .100
E(N) = 5.00764   E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	5.096	0.000
2	6.660	0.000
3	8.225	1.161
4	9.789	2.725
5	11.353	4.289
6	12.917	5.854
7	14.482	7.418
8	16.046	8.982
9	17.207	10.546
10	17.207	12.111
11	17.207	13.675

TEST II-32

K,SHAPE =2.5000   DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .100   INPUT BETA= .100
E(N) = 4.66812   E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	5.040	0.000
2	6.631	0.000
3	8.222	1.324
4	9.813	2.915
5	11.404	4.506
6	12.995	6.097
7	14.586	7.688
8	15.910	9.279
9	15.910	10.871
10	15.910	12.462

TEST II-33

K,SHAPE =2.8000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .100 INPUT BETA= .100
E(N) = 3.84948 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	4.910	0.000
2	6.583	.108
3	8.256	1.781
4	9.929	3.454
5	11.602	5.127
6	13.274	6.799
7	13.383	8.472
8	13.383	10.145

TEST II-34

K,SHAPE =3.0000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .100 INPUT BETA= .100
E(N) = 3.42853 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	4.851	0.000
2	6.579	.335
3	8.308	2.063
4	10.037	3.792
5	11.765	5.520
6	12.100	7.249
7	12.100	8.978

TEST II-35

K,SHAPE =3.3000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .100 INPUT BETA= .100
E(N) = 2.92770 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	4.793	0.000
2	6.607	.649
3	8.421	2.463
4	10.234	4.277
5	10.884	6.091
6	10.884	7.905

TEST II-36

K,SHAPE =3.6000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .100 INPUT BETA= .100
E(N) = 2.54019 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	4.754	0.000
2	6.565	.941
3	8.566	2.842
4	10.468	4.743
5	11.408	6.645
6	11.408	8.546

TEST II-37

K,SHAPE =3.9000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .100 INPUT BETA= .100
E(N) = 2.23347 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	4.757	0.000
2	6.748	1.215
3	8.739	3.206
4	9.954	5.197
5	9.954	7.188

TEST II-38

K,SHAPE =4.3000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .100 INPUT BETA= .100
E(N) = 1.91394 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	4.776	0.000
2	6.889	1.553
3	8.452	3.676
4	8.452	5.789

TEST II-39

K,SHAPE =4.6000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .100 INPUT BETA= .100
E(N) = 1.72329 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	4.807	0.000
2	7.014	1.814
3	8.829	4.021
4	8.828	6.228

TEST II-40

K,SHAPE =5.7000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .100 INPUT BETA= .100
E(N) = 1.24639 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	5.005	.126
2	7.570	2.692
3	7.697	5.257

Appendix E

Performance Evaluation Tables for SPRT's with Designated Risks of .20

ACCELERATED TEST W/O REPLACEMENT
INPUT ALPHA= .200 INPUT BETA= .200
MULTIPLICATION FACTOR= 1.50 NMAX= 5000

K	ALPHA	BETA	N(0)	N(1)	T(0)	T(1)
.50	.234	.205	37.15	40.87	5.892	5.953
.52	.224	.204	34.48	37.24	5.099	4.945
.54	.234	.202	32.65	35.00	4.817	4.647
.56	.241	.205	30.30	33.01	4.346	4.275
.58	.239	.202	27.90	31.08	3.842	3.935
.60	.235	.208	26.34	29.64	3.679	3.640
.63	.238	.186	24.71	27.20	3.428	3.112
.65	.242	.198	22.77	25.56	3.087	3.028
.68	.240	.193	21.38	24.05	2.990	2.785
.70	.240	.193	19.56	22.25	2.766	2.636
.73	.237	.191	18.50	20.69	2.654	2.347
.75	.241	.193	17.67	19.67	2.619	2.313
.80	.233	.184	15.50	17.63	2.341	2.020
.85	.244	.179	14.04	15.88	2.245	1.876
.90	.235	.181	12.64	14.50	2.067	1.737
.95	.242	.171	11.63	13.17	1.988	1.622
1.00	.243	.183	10.46	12.06	1.904	1.539
1.10	.251	.180	8.85	10.31	1.820	1.457
1.20	.241	.158	7.70	8.93	1.738	1.331
1.30	.251	.174	6.65	7.79	1.688	1.300
1.40	.245	.164	5.96	7.11	1.613	1.245
1.50	.246	.151	5.30	6.42	1.558	1.186
1.60	.233	.150	4.74	5.78	1.533	1.152
1.70	.237	.140	4.36	5.19	1.534	1.127
1.80	.249	.155	3.84	4.67	1.499	1.155
1.90	.236	.133	3.65	4.50	1.451	1.087
2.00	.242	.144	3.25	3.96	1.440	1.089
2.10	.234	.137	3.13	3.82	1.411	1.048
2.20	.231	.122	3.04	3.70	1.383	1.012
2.30	.243	.133	2.67	3.25	1.369	1.050
2.40	.248	.121	2.60	3.17	1.349	1.021
2.50	.223	.117	2.55	3.09	1.339	.997
2.80	.239	.117	2.11	2.56	1.298	1.018
3.00	.223	.110	2.02	2.49	1.281	.998
3.30	.202	.096	1.93	2.41	1.264	.982
3.60	.229	.105	1.55	1.89	1.212	.991
3.90	.226	.091	1.49	1.76	1.195	.944
4.30	.198	.068	1.41	1.62	1.178	.892
4.60	.200	.063	1.37	1.54	1.168	.886
5.70	.229	.070	1.00	1.00	1.137	.922

ACCELERATED TEST W/O REPLACEMENT
INPUT ALPHA= .200 INPUT BETA= .200
MULTIPLICATION FACTOR= 2.00 NMAX= 5000

K	ALPHA	BETA	N(0)	N(1)	T(0)	T(1)
.50	.216	.198	40.98	45.05	3.859	4.189
.52	.211	.191	38.54	41.23	3.680	3.505
.54	.223	.183	35.70	38.99	3.268	3.281
.56	.221	.193	33.57	36.79	3.091	2.874
.58	.214	.173	31.01	33.87	2.819	2.609
.60	.217	.183	28.81	32.25	2.589	2.503
.63	.203	.175	27.04	29.87	2.390	2.196
.65	.228	.176	25.55	28.17	2.295	2.106
.68	.224	.173	23.55	26.24	2.192	1.927
.70	.220	.170	22.20	24.48	2.090	1.823
.73	.220	.175	20.73	22.99	2.040	1.741
.75	.218	.171	19.23	21.89	1.903	1.689
.80	.225	.168	17.47	19.48	1.817	1.500
.85	.220	.163	15.65	17.40	1.732	1.360
.90	.210	.176	14.14	15.91	1.670	1.317
.95	.213	.156	12.79	14.50	1.622	1.264
1.00	.222	.156	11.71	13.57	1.554	1.234
1.10	.220	.148	9.71	11.53	1.481	1.154
1.20	.228	.157	8.49	9.93	1.485	1.108
1.30	.227	.150	7.44	8.77	1.434	1.054
1.40	.210	.147	6.46	7.84	1.429	1.051
1.50	.223	.136	5.76	6.88	1.450	1.040
1.60	.216	.140	5.26	6.23	1.436	1.010
1.70	.217	.137	4.79	5.72	1.432	1.002
1.80	.223	.135	4.34	5.25	1.416	1.007
1.90	.218	.128	4.13	5.03	1.369	.969
2.00	.204	.125	3.74	4.56	1.385	.973
2.10	.214	.125	3.40	4.12	1.388	.982
2.20	.209	.111	3.24	3.98	1.354	.949
2.30	.201	.109	3.09	3.82	1.322	.920
2.40	.218	.110	2.86	3.48	1.341	.957
2.50	.211	.106	2.74	3.36	1.316	.930
2.80	.202	.091	2.36	2.90	1.302	.943
3.00	.186	.079	2.21	2.79	1.279	.923
3.30	.184	.095	1.91	2.41	1.268	.976
3.60	.174	.072	1.82	2.23	1.243	.910
3.90	.188	.058	1.69	2.04	1.203	.862
4.30	.204	.075	1.41	1.63	1.177	.904
4.60	.210	.065	1.36	1.54	1.165	.883
5.70	.159	.039	1.24	1.34	1.157	.864

ACCELERATED TESTS WITH REPLACEMENT
MONTE CARLO SIZE= 1000
INPUT ALPHA= .200 INPUT BETA= .200
MULTIPLICATICN FACTOR= 2.00 NSTAND= 1

K	ALPHA	BETA	N(0)	N(1)	T(0)	T(1)
.50	.218	.210	40.81	45.21	122.807	92.528
.52	.218	.192	37.82	42.20	105.872	79.194
.54	.214	.172	34.81	38.51	92.551	66.838
.56	.212	.205	33.05	36.28	82.837	60.732
.58	.217	.183	30.48	33.89	72.481	53.219
.60	.227	.189	29.87	32.38	67.104	49.032
.63	.223	.184	27.14	30.12	57.842	42.990
.65	.214	.187	25.18	28.45	51.434	39.135
.68	.216	.190	23.33	26.58	46.314	34.988
.70	.214	.146	21.60	24.53	41.312	30.527
.73	.195	.181	20.24	22.69	37.881	27.902
.75	.216	.179	18.97	21.37	34.120	25.599
.80	.220	.176	17.18	19.80	29.242	22.650
.85	.222	.169	15.25	17.84	24.878	19.451
.90	.193	.174	14.01	15.97	22.461	16.930
.95	.208	.157	12.48	14.50	19.437	14.811
1.00	.202	.194	11.54	13.88	17.505	14.326
1.10	.200	.141	9.77	11.45	14.264	10.969
1.20	.226	.158	8.36	9.83	11.753	9.288
1.30	.215	.158	7.27	8.55	10.149	7.900
1.40	.215	.159	6.75	7.78	9.197	7.172
1.50	.220	.161	5.75	6.78	7.781	6.181
1.60	.227	.127	5.16	6.44	6.961	5.778
1.70	.241	.121	4.92	5.70	6.466	5.059
1.80	.213	.117	4.35	5.39	5.797	4.779
1.90	.198	.133	4.18	4.97	5.548	4.391
2.00	.195	.138	3.76	4.48	5.056	3.986
2.10	.237	.113	3.36	4.10	4.425	3.614
2.20	.211	.112	3.34	4.00	4.418	3.542
2.30	.220	.114	3.21	3.88	4.224	3.445
2.40	.214	.103	2.75	3.50	3.662	3.088
2.50	.199	.112	2.74	3.35	3.628	2.992
2.80	.223	.099	2.39	2.86	3.153	2.537
3.00	.188	.102	2.23	2.73	2.997	2.442
3.30	.182	.101	1.90	2.40	2.595	2.152
3.60	.211	.086	1.82	2.23	2.416	2.027
3.90	.160	.064	1.72	2.07	2.339	1.889
4.30	.215	.056	1.43	1.62	1.944	1.468
4.60	.168	.063	1.33	1.57	1.844	1.437
5.70	.174	.043	1.24	1.36	1.700	1.271

ACCELERATED TESTS WITH REPLACEMENT
MONTE CARLO SIZE = 1000
INPUT ALPHA= .200 INPUT BETA= .200
MULTIPLICATION FACTOR= 2.00 NSTAND= 2

K	ALPHA	BETA	N(0)	N(1)	T(0)	T(1)
.50	.207	.204	40.66	44.95	57.910	43.834
.52	.210	.181	37.54	42.53	49.653	38.287
.54	.200	.163	35.57	38.94	44.744	32.655
.56	.199	.187	32.50	36.28	38.863	29.248
.58	.218	.165	31.88	34.93	35.736	26.468
.60	.220	.180	28.66	33.24	30.987	24.434
.63	.224	.172	26.76	30.50	27.425	21.235
.65	.212	.163	25.42	28.09	25.143	18.638
.68	.193	.176	23.58	27.01	22.643	17.346
.70	.231	.188	23.06	24.59	20.847	15.446
.73	.219	.175	20.43	22.97	18.272	13.853
.75	.213	.189	19.25	21.46	16.849	12.702
.80	.221	.188	17.41	19.10	14.359	10.770
.85	.202	.179	15.60	17.27	12.628	9.356
.90	.211	.175	14.07	15.94	11.039	8.373
.95	.200	.180	12.01	15.08	9.395	7.840
1.00	.238	.182	11.67	13.22	8.638	6.657
1.10	.221	.157	9.97	11.42	7.268	5.573
1.20	.200	.176	8.31	9.89	6.073	4.779
1.30	.207	.132	7.72	8.78	5.533	4.092
1.40	.219	.133	6.40	7.87	4.573	3.673
1.50	.237	.146	5.67	6.88	4.046	3.249
1.60	.212	.135	5.25	6.37	3.792	2.962
1.70	.204	.146	4.77	5.68	3.480	2.666
1.80	.229	.149	4.43	5.22	3.231	2.446
1.90	.186	.129	4.02	4.99	3.023	2.353
2.00	.223	.112	3.75	4.57	2.810	2.162
2.10	.224	.126	3.31	4.15	2.528	1.988
2.20	.209	.104	3.31	3.90	2.538	1.847
2.30	.213	.112	3.11	3.87	2.407	1.869
2.40	.240	.101	2.90	3.45	2.243	1.676
2.50	.200	.107	2.81	3.38	2.224	1.671
2.80	.200	.100	2.33	2.86	1.936	1.433
3.00	.203	.094	2.26	2.81	1.886	1.434
3.30	.199	.101	1.93	2.43	1.698	1.286
3.60	.178	.059	1.85	2.21	1.662	1.143
3.90	.162	.071	1.67	2.00	1.569	1.073
4.30	.200	.067	1.40	1.62	1.363	.894
4.60	.185	.073	1.36	1.57	1.359	.895
5.70	.155	.045	1.22	1.35	1.322	.865

ACCELERATED TESTS WITH REPLACEMENT
MONTE CARLO SIZE = 1000
INPUT ALPHA= .200 INPUT BETA= .200
MULTIPLICATION FACTOR= 2.00 NSTAND= 3

K	ALPHA	BETA	N(0)	N(1)	T(0)	T(1)
.50	.209	.204	40.81	44.30	36.714	27.506
.52	.208	.183	38.00	41.50	31.742	23.969
.54	.214	.167	34.68	38.18	27.744	20.443
.56	.173	.176	32.62	36.81	24.997	19.018
.58	.210	.168	32.19	33.93	23.080	16.556
.60	.226	.180	28.09	32.24	19.299	15.234
.63	.208	.180	27.09	29.88	17.991	13.435
.65	.195	.177	25.37	28.12	16.232	12.181
.68	.207	.170	22.88	25.94	14.203	10.736
.70	.209	.210	22.23	24.49	13.241	10.165
.73	.235	.197	20.70	23.55	11.816	9.462
.75	.227	.178	18.91	21.26	10.689	8.115
.80	.217	.179	17.33	19.70	9.471	7.306
.85	.213	.191	15.39	17.50	8.125	6.310
.90	.207	.194	13.72	16.39	7.176	5.802
.95	.205	.173	12.80	14.28	6.504	4.839
1.00	.225	.167	11.49	13.31	5.761	4.446
1.10	.209	.170	10.13	11.51	4.990	3.791
1.20	.239	.156	8.43	9.76	4.089	3.130
1.30	.220	.165	7.60	8.62	3.709	2.785
1.40	.216	.136	6.75	7.81	3.328	2.506
1.50	.225	.144	5.87	6.74	2.923	2.169
1.60	.213	.157	5.12	6.22	2.642	2.029
1.70	.211	.144	4.80	5.82	2.504	1.916
1.80	.225	.122	4.31	5.22	2.278	1.703
1.90	.202	.121	4.10	4.88	2.221	1.613
2.00	.197	.130	3.84	4.58	2.121	1.559
2.10	.215	.108	3.42	4.16	1.930	1.410
2.20	.193	.103	3.22	3.92	1.893	1.345
2.30	.192	.116	3.18	3.78	1.857	1.329
2.40	.213	.112	2.85	3.46	1.716	1.228
2.50	.211	.097	2.76	3.38	1.684	1.205
2.80	.189	.128	2.30	2.87	1.522	1.088
3.00	.180	.079	2.24	2.73	1.503	1.034
3.30	.200	.095	1.92	2.41	1.367	.960
3.60	.195	.063	1.77	2.26	1.320	.917
3.90	.170	.065	1.52	2.03	1.291	.858
4.30	.193	.066	1.43	1.61	1.225	.793
4.60	.169	.055	1.38	1.55	1.232	.790
5.70	.142	.026	1.26	1.35	1.236	.799

ACCELERATED TESTS WITH REPLACEMENT
MONTE CARLO SIZE = 1000
INPUT ALPHA= .200 INPUT BETA= .200
MULTIPLICATION FACTOR= 2.00 NSTAND= 5

K	ALPHA	BETA	N(0)	N(1)	T(0)	T(1)
.50	.211	.201	40.11	44.58	19.740	15.452
.52	.217	.176	37.76	41.53	17.373	13.270
.54	.208	.169	34.72	38.76	15.343	11.671
.56	.184	.181	32.24	36.59	13.707	10.648
.58	.218	.173	31.24	33.79	12.446	9.358
.60	.206	.170	28.64	32.21	11.151	8.588
.63	.222	.178	27.57	30.76	10.151	7.959
.65	.191	.199	25.40	28.37	9.171	7.132
.68	.244	.210	24.16	26.30	8.224	6.461
.70	.218	.188	22.01	24.33	7.484	5.714
.73	.223	.172	20.95	23.07	6.899	5.236
.75	.220	.186	19.19	21.70	6.249	4.897
.80	.196	.181	17.22	19.80	5.475	4.300
.85	.179	.169	15.16	17.22	4.784	3.589
.90	.196	.174	14.10	15.86	4.322	3.265
.95	.215	.152	12.75	14.62	3.862	2.941
1.00	.243	.177	11.30	13.28	3.360	2.690
1.10	.228	.159	9.96	11.46	2.976	2.283
1.20	.228	.145	8.47	9.95	2.581	1.969
1.30	.208	.130	7.11	8.80	2.248	1.729
1.40	.242	.141	6.50	7.80	2.056	1.579
1.50	.230	.139	5.66	6.89	1.857	1.422
1.60	.216	.153	5.24	6.24	1.768	1.320
1.70	.236	.124	4.77	5.88	1.655	1.256
1.80	.215	.133	4.22	5.14	1.528	1.127
1.90	.217	.109	4.15	5.04	1.538	1.110
2.00	.213	.131	3.77	4.52	1.470	1.046
2.10	.225	.126	3.34	4.07	1.357	.959
2.20	.238	.116	3.24	3.99	1.331	.961
2.30	.226	.113	3.22	3.84	1.326	.942
2.40	.201	.119	2.80	3.52	1.268	.902
2.50	.210	.109	2.74	3.31	1.257	.861
2.80	.207	.101	2.36	2.94	1.180	.838
3.00	.166	.106	2.16	2.76	1.175	.819
3.30	.204	.092	1.93	2.40	1.119	.783
3.60	.172	.084	1.82	2.25	1.123	.768
3.90	.182	.056	1.72	2.04	1.114	.730
4.30	.203	.071	1.41	1.64	1.060	.704
4.60	.223	.061	1.37	1.57	1.062	.712
5.70	.148	.031	1.22	1.34	1.125	.722

Appendix F

Test Plans for Weibull SPRT's

with Designated Risks of .20

TEST III-1

K,SHAPE = .5000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .200 INPUT BETA= .200
E(N) = 43.25606 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	8.659	0.000	46	58.375	43.266
2	9.764	0.000	47	59.480	44.370
3	10.869	0.000	48	60.584	45.475
4	11.974	0.000	49	61.689	46.580
5	13.079	0.000	50	62.794	47.685
6	14.183	0.000	51	63.899	48.790
7	15.288	.179	52	65.004	49.894
8	15.393	1.284	53	66.108	50.999
9	17.498	2.389	54	67.213	52.104
10	18.602	3.493	55	68.318	53.209
11	19.707	4.598	56	69.423	54.314
12	20.812	5.703	57	70.528	55.418
13	21.917	6.808	58	71.632	56.523
14	23.022	7.912	59	72.737	57.628
15	24.126	9.017	60	73.842	58.733
16	25.231	10.122	61	74.947	59.838
17	26.336	11.227	62	76.052	60.942
18	27.441	12.332	63	77.156	62.047
19	28.546	13.436	64	78.261	63.152
20	29.650	14.541	65	79.366	64.257
21	30.755	15.646	66	80.471	65.361
22	31.860	16.751	67	81.575	66.466
23	32.965	17.856	68	82.680	67.571
24	34.070	18.960	69	83.785	68.676
25	35.174	20.055	70	84.890	69.781
26	36.279	21.170	71	85.995	70.885
27	37.384	22.275	72	87.099	71.990
28	38.489	23.379	73	88.204	73.095
29	39.593	24.484	74	89.309	74.200
30	40.698	25.589	75	90.414	75.305
31	41.803	26.694	76	91.519	76.409
32	42.908	27.799	77	92.623	77.514
33	44.013	28.903	78	93.728	78.619
34	45.117	30.008	79	94.833	79.724
35	46.222	31.113	80	95.938	80.829
36	47.327	32.218	81	96.117	81.933
37	48.432	33.323	82	96.117	83.038
38	49.537	34.427	83	96.117	84.143
39	50.641	35.532	84	96.117	85.248
40	51.746	36.637	85	96.117	86.352
41	52.851	37.742	86	96.117	87.457
42	53.956	38.847	87	96.117	88.562
43	55.061	39.951			
44	56.165	41.056			
45	57.270	42.161			

TEST III-2

K,SHAPE = .5200   DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .200   INPUT BETA= .200
E(N) = 40.09723   E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	8.402	0.000	46	58.312	43.727
2	9.511	0.000	47	59.421	44.836
3	10.620	0.000	48	60.530	45.945
4	11.729	0.000	49	61.640	47.054
5	12.838	0.000	50	62.749	48.164
6	13.947	0.000	51	63.858	49.273
7	15.056	.471	52	64.967	50.382
8	16.166	1.580	53	66.076	51.491
9	17.275	2.690	54	67.185	52.600
10	18.384	3.799	55	68.294	53.709
11	19.493	4.908	56	69.403	54.818
12	20.602	6.017	57	70.513	55.927
13	21.711	7.126	58	71.622	57.037
14	22.820	8.235	59	72.731	58.146
15	23.929	9.344	60	73.840	59.255
16	25.038	10.453	61	74.949	60.364
17	26.148	11.563	62	76.058	61.473
18	27.257	12.672	63	77.167	62.582
19	28.366	13.781	64	78.276	63.691
20	29.475	14.890	65	79.386	64.800
21	30.584	15.999	66	80.495	65.910
22	31.693	17.108	67	81.604	67.019
23	32.802	18.217	68	82.713	68.128
24	33.911	19.326	69	83.822	69.237
25	35.021	20.436	70	84.931	70.346
26	36.130	21.545	71	86.040	71.455
27	37.239	22.654	72	87.149	72.564
28	38.348	23.763	73	88.258	73.673
29	39.457	24.872	74	89.368	74.783
30	40.566	25.981	75	89.839	75.892
31	41.675	27.090	76	89.839	77.001
32	42.784	28.199	77	89.839	78.110
33	43.894	29.309	78	89.839	79.219
34	45.003	30.418	79	89.839	80.328
35	46.112	31.527	80	89.839	81.437
36	47.221	32.636	81	89.839	82.546
37	48.330	33.745			
38	49.439	34.854			
39	50.548	35.963			
40	51.657	37.072			
41	52.767	38.182			
42	53.876	39.291			
43	54.985	40.400			
44	56.094	41.509			
45	57.203	42.618			

TEST III-3

K,SHAPE = .5400 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .200 INPUT BETA= .200
E(N) = 37.27915 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	8.163	0.000	46	58.269	44.170
2	9.277	0.000	47	59.383	45.283
3	10.390	0.000	48	60.496	46.396
4	11.504	0.000	49	61.610	47.510
5	12.617	0.000	50	62.723	48.623
6	13.731	0.000	51	63.837	49.737
7	14.844	.744	52	64.950	50.850
8	15.958	1.858	53	66.064	51.964
9	17.071	2.971	54	67.177	53.077
10	18.185	4.085	55	68.291	54.191
11	19.298	5.198	56	69.404	55.304
12	20.412	6.312	57	70.518	56.418
13	21.525	7.425	58	71.631	57.531
14	22.638	8.539	59	72.745	58.645
15	23.752	9.652	60	73.858	59.758
16	24.865	10.766	61	74.971	60.872
17	25.979	11.879	62	76.085	61.985
18	27.092	12.992	63	77.198	63.098
19	28.206	14.106	64	78.312	64.212
20	29.319	15.219	65	79.425	65.325
21	30.433	16.333	66	80.539	66.439
22	31.546	17.446	67	81.652	67.552
23	32.660	18.560	68	82.766	68.666
24	33.773	19.673	69	83.510	69.779
25	34.887	20.787	70	83.510	70.893
26	36.000	21.900	71	83.510	72.006
27	37.114	23.014	72	83.510	73.120
28	38.227	24.127	73	83.510	74.233
29	39.340	25.241	74	83.510	75.347
30	40.454	26.354	75	83.510	76.460
31	41.567	27.468			
32	42.681	28.581			
33	43.794	29.694			
34	44.908	30.808			
35	46.021	31.921			
36	47.135	33.035			
37	48.248	34.148			
38	49.362	35.262			
39	50.475	36.375			
40	51.589	37.489			
41	52.702	38.602			
42	53.816	39.716			
43	54.929	40.829			
44	56.043	41.943			
45	57.156	43.056			

TEST III-4

K,SHAPE = .5600 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .200 INPUT BETA= .200
E(N) = 34.75429 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	7.943	0.000
2	9.060	0.000
3	10.178	0.000
4	11.296	0.000
5	12.414	0.000
6	13.532	0.000
7	14.650	1.000
8	15.767	2.118
9	16.885	3.236
10	18.003	4.353
11	19.121	5.471
12	20.239	6.589
13	21.356	7.707
14	22.474	8.825
15	23.592	9.943
16	24.710	11.060
17	25.828	12.178
18	26.946	13.296
19	28.063	14.414
20	29.181	15.532
21	30.299	16.650
22	31.417	17.767
23	32.535	18.885
24	33.653	20.003
25	34.770	21.121
26	35.888	22.239
27	37.006	23.356
28	38.124	24.474
29	39.242	25.592
30	40.359	26.710
31	41.477	27.828
32	42.595	28.946
33	43.713	30.063
34	44.831	31.181
35	45.949	32.299
36	47.066	33.417
37	48.184	34.535
38	49.302	35.653
39	50.420	36.770
40	51.538	37.888
41	52.655	39.006
42	53.773	40.124
43	54.891	41.242
44	56.009	42.359
45	57.127	43.477
46	58.245	44.595
47	59.362	45.713
48	60.480	46.831
49	61.598	47.949
50	62.716	49.065
51	63.834	50.184
52	64.952	51.302
53	66.069	52.420
54	67.187	53.538
55	68.305	54.656
56	69.423	55.773
57	70.541	56.891
58	71.658	58.009
59	72.776	59.127
60	73.894	60.245
61	75.012	61.362
62	76.130	62.480
63	77.248	63.598
64	78.248	64.716
65	78.248	65.834
66	78.248	66.952
67	78.248	68.069
68	78.248	69.187
69	78.248	70.305
70	78.248	71.423

TEST III-5

K,SHAPE = .5800 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .200 INPUT BETA= .200
E(N) = 32.48314 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	7.737	0.000	46	58.236	45.006
2	8.860	0.000	47	59.358	46.128
3	9.982	0.000	48	60.480	47.250
4	11.104	0.000	49	61.602	48.372
5	12.226	0.000	50	62.725	49.494
6	13.348	.118	51	63.847	50.617
7	14.470	1.240	52	64.969	51.739
8	15.593	2.362	53	66.091	52.861
9	16.715	3.485	54	67.213	53.983
10	17.837	4.607	55	68.336	55.105
11	18.959	5.729	56	69.458	56.227
12	20.081	6.851	57	70.580	57.350
13	21.204	7.973	58	71.702	58.472
14	22.326	9.095	59	72.824	59.594
15	23.448	10.218	60	72.942	60.716
16	24.570	11.340	61	72.942	61.838
17	25.692	12.462	62	72.942	62.961
18	26.815	13.584	63	72.942	64.083
19	27.937	14.706	64	72.942	65.205
20	29.059	15.829	65	72.942	66.327
21	30.181	16.951			
22	31.303	18.073			
23	32.426	19.195			
24	33.548	20.317			
25	34.670	21.440			
26	35.792	22.562			
27	36.914	23.684			
28	38.036	24.806			
29	39.159	25.928			
30	40.281	27.051			
31	41.403	28.173			
32	42.525	29.295			
33	43.647	30.417			
34	44.770	31.539			
35	45.892	32.661			
36	47.014	33.784			
37	48.136	34.906			
38	49.258	36.028			
39	50.381	37.150			
40	51.503	38.272			
41	52.625	39.395			
42	53.747	40.517			
43	54.869	41.639			
44	55.991	42.761			
45	57.114	43.883			

TEST III-6

K,SHAPE = .6000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .200 INPUT BETA= .200
E(N) = 30.43262 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	7.546	0.000	46	58.242	45.402
2	8.673	0.000	47	59.368	46.529
3	9.799	0.000	48	60.495	47.655
4	10.926	0.000	49	61.621	48.782
5	12.052	0.000	50	62.748	49.909
6	13.179	.340	51	63.874	51.035
7	14.306	1.466	52	65.001	52.162
8	15.432	2.593	53	66.128	53.288
9	16.559	3.720	54	67.254	54.415
10	17.685	4.846	55	68.381	55.542
11	18.812	5.973	56	68.721	56.668
12	19.938	7.099	57	68.721	57.795
13	21.065	8.226	58	68.721	58.921
14	22.192	9.352	59	68.721	60.048
15	23.318	10.479	60	68.721	61.174
16	24.445	11.605	61	68.721	62.301
17	25.571	12.732			
18	26.698	13.859			
19	27.824	14.985			
20	28.951	16.112			
21	30.077	17.238			
22	31.204	18.365			
23	32.331	19.491			
24	33.457	20.618			
25	34.584	21.745			
26	35.710	22.871			
27	36.837	23.998			
28	37.963	25.124			
29	39.090	25.251			
30	40.217	27.377			
31	41.343	28.504			
32	42.470	29.631			
33	43.596	30.757			
34	44.723	31.884			
35	45.849	33.010			
36	46.975	34.137			
37	48.103	35.263			
38	49.229	36.390			
39	50.356	37.517			
40	51.482	38.643			
41	52.609	39.770			
42	53.735	40.896			
43	54.862	42.023			
44	55.989	43.149			
45	57.115	44.276			

TEST III-7

K,SHAPE = .6250 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .200 INPUT BETA= .200
E(N) = 28.13776 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	7.325	0.000
2	8.457	0.000
3	9.589	0.000
4	10.721	0.000
5	11.853	0.000
6	12.985	.599
7	14.117	1.732
8	15.249	2.864
9	16.381	3.996
10	17.513	5.128
11	18.645	6.260
12	19.777	7.392
13	20.910	8.524
14	22.042	9.656
15	23.174	10.788
16	24.306	11.920
17	25.438	13.052
18	26.570	14.184
19	27.702	15.316
20	28.834	15.448
21	29.966	17.580
22	31.098	18.712
23	32.230	19.844
24	33.362	20.976
25	34.494	22.109
26	35.626	23.241
27	36.758	24.373
28	37.890	25.505
29	39.022	26.637
30	40.154	27.769
31	41.286	28.901
32	42.419	30.033
33	43.551	31.165
34	44.683	32.297
35	45.815	33.429
36	46.947	34.561
37	48.079	35.693
38	49.211	36.825
39	50.343	37.957
40	51.475	39.089
41	52.607	40.221
42	53.739	41.353
43	54.871	42.485
44	56.003	43.618
45	57.135	44.750
46	58.267	45.882
47	59.399	47.014
48	60.531	48.146
49	61.663	49.278
50	62.796	50.410
51	63.928	51.542
52	64.527	52.674
53	64.527	53.806
54	64.527	54.938
55	64.527	56.070
56	64.527	57.202
57	64.527	58.334

TEST III-8

K,SHAPE = .6500 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .200 INPUT BETA= .200
E(N) = 26.09926 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	7.121	0.000	46	58.311	46.344
2	8.259	0.000	47	59.449	47.482
3	9.396	0.000	48	60.291	48.619
4	10.534	0.000	49	60.291	49.757
5	11.671	0.000	50	60.291	50.894
6	12.809	.842	51	60.291	52.032
7	13.946	1.979	52	60.291	53.169
8	15.084	3.117	53	60.291	54.307
9	16.222	4.254			
10	17.359	5.392			
11	18.497	6.530			
12	19.634	7.667			
13	20.772	8.805			
14	21.909	9.942			
15	23.047	11.080			
16	24.185	12.217			
17	25.322	13.355			
18	26.460	14.492			
19	27.597	15.630			
20	28.735	16.768			
21	29.872	17.905			
22	31.010	19.043			
23	32.147	20.180			
24	33.285	21.318			
25	34.423	22.455			
26	35.560	23.593			
27	36.698	24.730			
28	37.835	25.868			
29	38.973	27.006			
30	40.110	28.143			
31	41.248	29.281			
32	42.385	30.418			
33	43.523	31.556			
34	44.661	32.693			
35	45.798	33.831			
36	46.936	34.968			
37	48.073	36.106			
38	49.211	37.244			
39	50.348	38.381			
40	51.486	39.519			
41	52.623	40.656			
42	53.761	41.794			
43	54.899	42.931			
44	56.036	44.069			
45	57.174	45.207			

TEST III-9

K,SHAPE = .6750 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .200 INPUT BETA= .200
E(N) = 24.28009 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	6.933	0.000	46	56.011	46.792
2	8.076	0.000	47	56.011	47.935
3	9.219	0.000	48	56.011	49.078
4	10.362	0.000	49	56.011	50.221
5	11.505	0.000			
6	12.648	1.069			
7	13.791	2.212			
8	14.935	3.355			
9	16.078	4.498			
10	17.221	5.641			
11	18.364	6.784			
12	19.507	7.927			
13	20.650	9.070			
14	21.793	10.213			
15	22.936	11.356			
16	24.079	12.499			
17	25.222	13.642			
18	26.365	14.785			
19	27.508	15.929			
20	28.652	17.072			
21	29.795	18.215			
22	30.938	19.358			
23	32.081	20.501			
24	33.224	21.644			
25	34.367	22.787			
26	35.510	23.930			
27	36.653	25.073			
28	37.796	26.216			
29	38.939	27.359			
30	40.082	28.502			
31	41.225	29.645			
32	42.368	30.789			
33	43.512	31.932			
34	44.655	33.075			
35	45.798	34.218			
36	46.941	35.361			
37	48.084	36.504			
38	49.227	37.647			
39	50.370	38.790			
40	51.513	39.933			
41	52.656	41.076			
42	53.799	42.219			
43	54.942	43.362			
44	56.011	44.506			
45	56.011	45.649			

TEST III-10

K,SHAPE = .7000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .200 INPUT BETA= .200
E(N) = 22.64959 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT	TEST	ACCEPT	REJECT
1	6.759	0.000	46	52.836	47.226
2	7.907	0.000			
3	9.056	0.000			
4	10.205	0.000			
5	11.353	.133			
6	12.502	1.281			
7	13.651	2.430			
8	14.799	3.579			
9	15.948	4.727			
10	17.096	5.876			
11	18.245	7.025			
12	19.394	8.173			
13	20.542	9.322			
14	21.691	10.470			
15	22.839	11.619			
16	23.988	12.768			
17	25.137	13.916			
18	26.285	15.065			
19	27.434	16.214			
20	28.583	17.362			
21	29.731	18.511			
22	30.880	19.659			
23	32.028	20.808			
24	33.177	21.957			
25	34.326	23.105			
26	35.474	24.254			
27	36.623	25.402			
28	37.771	26.551			
29	38.920	27.700			
30	40.069	28.848			
31	41.217	29.997			
32	42.366	31.146			
33	43.515	32.294			
34	44.663	33.443			
35	45.812	34.591			
36	46.960	35.740			
37	48.109	36.889			
38	49.258	38.037			
39	50.406	39.186			
40	51.555	40.334			
41	52.704	41.483			
42	52.836	42.632			
43	52.836	43.780			
44	52.836	44.929			
45	52.836	46.078			

TEST III-11

K,SHAPE = .7250   DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .200   INPUT BETA= .200
E(N) = 21.18266   E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	6.597	0.000
2	7.751	0.000
3	8.905	0.000
4	10.060	0.000
5	11.214	.328
6	12.368	1.482
7	13.522	2.636
8	14.676	3.790
9	15.830	4.945
10	16.985	6.099
11	18.139	7.253
12	19.293	8.407
13	20.447	9.561
14	21.601	10.715
15	22.756	11.870
16	23.910	13.024
17	25.064	14.178
18	26.218	15.332
19	27.372	16.486
20	28.526	17.640
21	29.681	18.795
22	30.835	19.949
23	31.989	21.103
24	33.143	22.257
25	34.297	23.411
26	35.451	24.566
27	36.606	25.720
28	37.760	26.874
29	38.914	28.028
30	40.068	29.182
31	41.222	30.336
32	42.376	31.491
33	43.531	32.645
34	44.685	33.799
35	45.839	34.953
36	46.993	36.107
37	48.147	37.261
38	49.301	38.416
39	49.629	39.570
40	49.629	40.724
41	49.629	41.878
42	49.629	43.032
43	49.629	44.186

K,SHAPE = .7500 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .200 INPUT BETA= .200
E(N) = 19.85774 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	6.447	0.000
2	7.606	0.000
3	8.766	0.000
4	9.926	0.000
5	11.086	.512
6	12.245	1.672
7	13.405	2.831
8	14.565	3.991
9	15.725	5.151
10	16.884	6.311
11	18.044	7.470
12	19.204	8.630
13	20.364	9.790
14	21.523	10.949
15	22.683	12.109
16	23.843	13.269
17	25.003	14.429
18	26.162	15.588
19	27.322	16.748
20	28.482	17.908
21	29.642	19.068
22	30.801	20.227
23	31.961	21.387
24	33.121	22.547
25	34.281	23.707
26	35.440	24.866
27	36.600	26.026
28	37.760	27.186
29	38.919	28.346
30	40.079	29.505
31	41.239	30.665
32	42.399	31.825
33	43.558	32.985
34	44.718	34.144
35	45.878	35.304
36	46.390	36.464
37	46.390	37.624
38	46.390	38.783
39	46.390	39.943
40	46.390	41.103

TEST III-13

K,SHAPE = .8000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .200 INPUT BETA= .200
E(N) = 17.56535 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	6.175	0.000
2	7.346	0.000
3	8.517	0.000
4	9.688	0.000
5	10.859	.850
6	12.030	2.021
7	13.201	3.192
8	14.372	4.363
9	15.543	5.534
10	16.714	6.705
11	17.885	7.876
12	19.056	9.047
13	20.227	10.218
14	21.397	11.389
15	22.568	12.560
16	23.739	13.731
17	24.910	14.902
18	26.081	16.073
19	27.252	17.244
20	28.423	18.414
21	29.594	19.585
22	30.765	20.756
23	31.936	21.927
24	33.107	23.098
25	34.278	24.269
26	35.449	25.440
27	36.620	26.611
28	37.791	27.782
29	38.962	28.953
30	40.132	30.124
31	41.303	31.295
32	42.154	32.466
33	42.154	33.637
34	42.154	34.808
35	42.154	35.979
36	42.154	37.149

TEST III-14

K,SHAPE = .8500 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .200 INPUT BETA= .200
E(N) = 15.65935 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	5.937	0.000
2	7.120	0.000
3	8.302	0.000
4	9.484	0.000
5	10.666	1.156
6	11.848	2.338
7	13.031	3.520
8	14.213	4.702
9	15.395	5.885
10	16.577	7.067
11	17.759	8.249
12	18.942	9.431
13	20.124	10.613
14	21.306	11.796
15	22.488	12.978
16	23.670	14.160
17	24.853	15.342
18	26.035	16.524
19	27.217	17.707
20	28.399	18.889
21	29.581	20.071
22	30.764	21.253
23	31.946	22.435
24	33.128	23.618
25	34.310	24.800
26	35.493	25.982
27	36.675	27.154
28	37.830	28.346
29	37.830	29.529
30	37.830	30.711
31	37.830	31.893
32	37.830	33.075

TEST III-15

K,SHAPE = .9000　　　DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .200　　INPUT BETA= .200
E(N) = 14.05699　　E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	5.728	0.000
2	6.921	0.000
3	8.115	0.000
4	9.308	.240
5	10.502	1.434
6	11.695	2.627
7	12.889	3.821
8	14.082	5.014
9	15.276	6.208
10	16.469	7.401
11	17.663	8.595
12	18.857	9.788
13	20.050	10.982
14	21.244	12.175
15	22.437	13.369
16	23.631	14.562
17	24.824	15.756
18	26.018	16.949
19	27.211	18.143
20	28.405	19.337
21	29.598	20.530
22	30.792	21.724
23	31.985	22.917
24	33.179	24.111
25	34.372	25.304
26	34.612	26.498
27	34.612	27.691
28	34.612	28.885
29	34.612	30.078

TEST III-16

K,SHAPE = .9500 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .200 INPUT BETA= .200
E(N) = 12.69656 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	5.541	0.000
2	6.746	0.000
3	7.951	0.000
4	9.156	.483
5	10.361	1.688
6	11.566	2.893
7	12.771	4.098
8	13.976	5.303
9	15.181	6.508
10	16.386	7.713
11	17.591	8.918
12	18.796	10.123
13	20.001	11.328
14	21.206	12.533
15	22.410	13.737
16	23.615	14.942
17	24.820	16.147
18	26.025	17.352
19	27.230	18.557
20	28.435	19.752
21	29.640	20.967
22	30.845	22.172
23	31.328	23.377
24	31.328	24.582
25	31.328	25.787
26	31.328	26.992

TEST III-17

K,SHAPE =1.0000 DISCRIMINATION RATIO= 1.300
INPUT ALPHA= .200 INPUT BETA= .200
E(N) = 11.53135 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	5.375	0.000
2	6.592	0.000
3	7.808	0.000
4	9.024	.707
5	10.241	1.923
6	11.457	3.139
7	12.674	4.356
8	13.890	5.572
9	15.106	6.789
10	16.323	8.005
11	17.539	9.221
12	18.756	10.438
13	19.972	11.654
14	21.188	12.871
15	22.405	14.087
16	23.621	15.303
17	24.838	16.520
18	26.054	17.736
19	27.270	18.953
20	28.487	20.169
21	29.193	21.385
22	29.193	22.602
23	29.193	23.818
24	29.193	25.035

K,SHAPE =1.1000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .200 INPUT BETA= .200
E(N) = 9.65073 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	5.092	0.000
2	6.332	0.000
3	7.571	0.000
4	8.811	1.105
5	10.050	2.345
6	11.290	3.584
7	12.529	4.824
8	13.769	6.064
9	15.008	7.303
10	16.248	8.543
11	17.488	9.782
12	18.727	11.022
13	19.967	12.261
14	21.206	13.501
15	22.446	14.740
16	23.685	15.980
17	24.791	17.219
18	24.791	18.459
19	24.791	19.698
20	24.791	20.938

TEST III-19

K,SHAPE =1.2000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .200 INPUT BETA= .200
E(N) = 8.21129 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	4.861	0.000
2	6.124	0.000
3	7.387	.190
4	8.650	1.453
5	9.913	2.716
6	11.176	3.979
7	12.439	5.242
8	13.702	6.505
9	14.965	7.768
10	16.228	9.031
11	17.491	10.294
12	18.753	11.557
13	20.016	12.820
14	21.279	14.083
15	21.470	15.346
16	21.470	16.609
17	21.470	17.871

TEST III-20

K,SHAPE =1.3000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .200 INPUT BETA= .200
E(N) = 7.08400 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	4.670	0.000
2	5.957	0.000
3	7.244	.476
4	8.530	1.753
5	9.817	3.049
6	11.103	4.336
7	12.390	5.622
8	13.677	6.909
9	14.963	8.196
10	16.250	9.482
11	17.536	10.769
12	18.823	12.055
13	19.299	13.342
14	19.299	14.629
15	19.299	15.915

TEST III-21

K,SHAPE =1.4000   DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .200   INPUT BETA= .200
E(N)   =   6.18391 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	4.511	0.000
2	5.822	0.000
3	7.132	.731
4	8.443	2.042
5	9.753	3.352
6	11.064	4.663
7	12.374	5.973
8	13.685	7.284
9	14.995	8.594
10	16.306	9.905
11	17.037	11.215
12	17.037	12.526
13	17.037	13.836

TEST III-22

K,SHAPE =1.5000   DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .200   INPUT BETA= .200
E(N)   =   5.45325 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	4.377	0.000
2	5.712	0.000
3	7.047	.962
4	8.381	2.297
5	9.716	3.631
6	11.051	4.966
7	12.385	6.301
8	13.720	7.636
9	14.682	8.970
10	14.682	10.305
11	14.682	11.640

TEST III-23

K,SHAPE =1.6000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .200 INPUT BETA= .200
E(N) = 4.85154 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	4.264	0.000
2	5.623	0.000
3	6.982	1.173
4	8.341	2.532
5	9.700	3.892
6	11.060	5.251
7	12.419	6.610
8	13.592	7.969
9	13.592	9.328
10	13.592	10.688

TEST III-24

K,SHAPE =1.7000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .200 INPUT BETA= .200
E(N) = 4.34978 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	4.167	0.000
2	5.551	0.000
3	6.935	1.368
4	8.319	2.752
5	9.703	4.136
6	11.087	5.520
7	12.455	6.904
8	12.455	8.288
9	12.455	9.672

TEST III-25

K,SHAPE =1.8000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .200 INPUT BETA= .200
E(N) = 3.92672 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	4.085	0.000
2	5.494	.142
3	6.903	1.551
4	8.312	2.959
5	9.721	4.358
6	11.130	5.777
7	11.271	7.186
8	11.271	8.595

TEST III-26

K,SHAPE =1.9000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .200 INPUT BETA= .200
E(N) = 3.56650 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	4.015	0.000
2	5.449	.288
3	6.883	1.722
4	8.317	3.156
5	9.752	4.590
6	11.186	6.024
7	11.473	7.458
8	11.473	8.893

TEST III-27

K,SHAPE =2.0000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .200 INPUT BETA= .200
E(N) = 3.25709 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	3.955	0.000
2	5.415	.424
3	6.874	1.884
4	8.334	3.343
5	9.794	4.803
6	10.218	5.253
7	10.218	7.722

TEST III-28

K,SHAPE =2.1000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .200 INPUT BETA= .200
E(N) = 2.98920 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	3.904	0.000
2	5.389	.552
3	6.875	2.038
4	8.360	3.523
5	8.913	5.009
6	8.913	6.494

TEST III-29

K,SHAPE =2.2000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .200 INPUT BETA= .200
E(N) = 2.75561 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	3.860	0.000
2	5.372	.674
3	6.883	2.185
4	8.395	3.697
5	9.069	5.208
6	9.069	6.720

TEST III-30

K,SHAPE =2.3000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .200 INPUT BETA= .200
E(N) = 2.55059 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	3.824	0.000
2	5.361	.790
3	6.899	2.327
4	8.437	3.865
5	9.225	5.403
6	9.226	6.940

TEST III-31

K,SHAPE =2.4000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .200 INPUT BETA= .200
E(N) = 2.36960 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	3.793	0.000
2	5.357	.900
3	6.921	2.464
4	7.821	4.029
5	7.821	5.593

TEST III-32

K,SHAPE =2.5000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .200 INPUT BETA= .200
E(N) = 2.20894 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	3.767	0.000
2	5.358	1.006
3	6.949	2.597
4	7.955	4.188
5	7.955	5.779

TEST III-33

K,SHAPE =2.8000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .200 INPUT BETA= .200
E(N) = 1.82157 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	3.715	0.000
2	5.388	1.303
3	6.691	2.976
4	6.691	4.649

TEST III-34

K,SHAPE =3.0000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .200 INPUT BETA= .200
E(N) = 1.62237 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	3.699	0.000
2	5.427	1.487
3	6.914	3.216
4	6.914	4.944

TEST III-35

K,SHAPE =3.3000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .200 INPUT BETA= .200
E(N) = 1.38538 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	3.693	0.000
2	5.442	1.749
3	5.442	3.552

TEST III-36

K,SHAPE =3.6000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .200 INPUT BETA= .200
E(N) = 1.20201 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	3.707	.096
2	5.609	1.997
3	5.704	3.898

TEST III-37

K,SHAPE =3.9000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .200 INPUT BETA= .200
E(N) = 1.05687 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	3.736	.246
2	5.727	2.236
3	5.973	4.227

TEST III-38

K,SHAPE =4.3000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .200 INPUT BETA= .200
E(N) = .90567 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	3.793	.433
2	4.226	2.546

TEST III-39

K,SHAPE =4.6000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .200 INPUT BETA= .200
E(N) = .81546 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	3.847	.567
2	4.414	2.774

TEST III-40

K,SHAPE =5.7000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .200 INPUT BETA= .200
E(N) = .58979 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	4.104	1.027
2	5.131	3.592

Appendix G

<u>Performance Evaluation Tables for SPRT's</u>

<u>with Designated Risks of .30</u>

ACCELERATED TEST W/O REPLACEMENT
INPUT ALPHA= .300 INPUT BETA= .300
MULTIPLICATION FACTOR= 1.50 NMAX= 5000

K	ALPHA	BETA	N(0)	N(1)	T(0)	T(1)
.50	.333	.272	16.34	17.79	5.147	4.709
.52	.334	.290	15.39	16.55	4.713	4.362
.54	.335	.285	14.28	15.37	4.317	3.919
.56	.337	.287	13.48	14.63	3.865	3.574
.58	.348	.278	12.49	13.46	3.675	3.274
.60	.346	.273	11.75	13.01	3.434	3.179
.63	.343	.269	11.22	12.17	3.229	2.797
.65	.339	.272	10.20	11.06	3.080	2.671
.68	.346	.270	9.58	10.45	2.865	2.492
.70	.353	.261	8.95	9.87	2.691	2.310
.73	.352	.267	8.42	9.33	2.639	2.298
.75	.349	.252	8.22	9.18	2.428	2.119
.80	.350	.257	7.19	7.95	2.343	1.952
.85	.340	.255	6.53	7.24	2.189	1.778
.90	.344	.259	5.95	6.54	2.070	1.659
.95	.352	.265	5.33	6.02	1.963	1.628
1.00	.354	.242	5.17	5.78	1.858	1.462
1.10	.358	.242	4.22	4.71	1.785	1.421
1.20	.342	.224	4.00	4.46	1.661	1.275
1.30	.339	.231	3.41	3.84	1.583	1.220
1.40	.361	.225	2.89	3.29	1.499	1.206
1.50	.347	.221	2.81	3.17	1.454	1.133
1.60	.374	.207	2.32	2.62	1.378	1.120
1.70	.349	.211	2.28	2.56	1.370	1.092
1.80	.352	.203	2.24	2.55	1.343	1.075
1.90	.333	.202	2.18	2.48	1.333	1.037
2.00	.368	.207	1.73	1.95	1.265	1.073
2.10	.368	.200	1.71	1.94	1.254	1.066
2.20	.358	.203	1.66	1.88	1.229	1.031
2.30	.361	.184	1.64	1.82	1.216	.980
2.40	.340	.184	1.59	1.76	1.194	.955
2.50	.360	.168	1.56	1.71	1.168	.921
2.80	.315	.150	1.48	1.60	1.165	.885
3.00	.398	.179	1.00	1.00	1.068	.863
3.30	.379	.163	1.00	1.00	1.083	.874
3.60	.353	.152	1.00	1.00	1.094	.877
3.90	.336	.139	1.00	1.00	1.103	.896
4.30	.309	.127	1.00	1.00	1.114	.896
4.60	.290	.108	1.00	1.00	1.121	.904
5.70	.223	.076	1.00	1.00	1.140	.920

ACCELERATED TEST W/O REPLACEMENT
INPUT ALPHA= .300 INPUT BETA= .300
MULTIPLICATION FACTOR= 2.00 NMAX= 5000

K	ALPHA	BETA	N(0)	N(1)	T(0)	T(1)
.50	.318	.276	18.24	19.85	3.831	3.634
.52	.326	.273	17.14	18.78	3.548	3.476
.54	.332	.272	15.90	17.13	3.198	2.912
.56	.327	.260	15.00	16.09	2.956	2.641
.58	.330	.259	14.16	15.42	2.838	2.582
.60	.325	.255	13.39	14.49	2.784	2.427
.63	.339	.260	12.39	13.28	2.604	2.205
.65	.317	.251	11.88	12.68	2.477	2.048
.68	.333	.250	10.96	11.84	2.384	1.938
.70	.317	.249	10.10	11.32	2.180	1.888
.73	.337	.247	9.72	10.60	2.121	1.708
.75	.327	.240	9.19	10.11	2.064	1.655
.80	.325	.254	8.23	9.16	1.947	1.588
.85	.326	.254	7.24	8.12	1.878	1.510
.90	.329	.221	6.72	7.49	1.812	1.394
.95	.328	.236	6.26	6.94	1.750	1.367
1.00	.338	.226	5.72	6.35	1.690	1.285
1.10	.335	.222	4.80	5.44	1.652	1.267
1.20	.354	.213	4.27	4.79	1.574	1.167
1.30	.342	.217	3.74	4.22	1.530	1.161
1.40	.330	.206	3.51	3.94	1.433	1.034
1.50	.340	.190	3.15	3.54	1.435	1.048
1.60	.344	.220	2.73	3.06	1.410	1.089
1.70	.337	.184	2.63	2.98	1.372	1.022
1.80	.321	.184	2.54	2.88	1.343	.988
1.90	.331	.197	2.19	2.49	1.326	1.048
2.00	.330	.182	2.15	2.46	1.314	1.025
2.10	.321	.171	2.11	2.41	1.302	.993
2.20	.324	.166	2.02	2.30	1.260	.950
2.30	.319	.155	1.93	2.20	1.225	.909
2.40	.353	.160	1.60	1.77	1.193	.944
2.50	.346	.169	1.55	1.73	1.178	.934
2.80	.327	.136	1.49	1.61	1.162	.881
3.00	.331	.128	1.44	1.55	1.144	.859
3.30	.309	.109	1.39	1.46	1.137	.834
3.60	.340	.158	1.00	1.00	1.097	.886
3.90	.333	.138	1.00	1.00	1.105	.889
4.30	.306	.126	1.00	1.00	1.115	.897
4.60	.290	.113	1.00	1.00	1.121	.903
5.70	.225	.075	1.00	1.00	1.138	.923

ACCELERATED TESTS WITH REPLACEMENT
MONTE CARLO SIZE= 1000
INPUT ALPHA= .300 INPUT BETA= .300
MULTIPLICATICN FACTOR= 2.00 NSTAND= 1

K	ALPHA	BETA	N(0)	N(1)	T(0)	T(1)
.50	.295	.250	18.50	19.54	56.722	38.506
.52	.320	.283	16.79	18.06	47.920	34.510
.54	.326	.280	15.95	17.63	41.955	31.355
.56	.331	.283	15.07	16.43	37.088	27.852
.58	.345	.253	14.39	15.50	33.399	24.489
.60	.332	.282	13.46	14.01	30.165	21.693
.63	.316	.266	12.24	13.56	26.541	19.432
.65	.368	.253	11.80	12.64	23.224	17.356
.68	.335	.264	10.95	11.78	21.637	15.517
.70	.275	.263	9.90	11.15	19.835	14.254
.73	.309	.230	9.55	10.60	17.658	12.786
.75	.318	.267	9.20	9.99	16.590	11.972
.80	.326	.240	8.30	9.09	14.066	10.218
.85	.334	.265	7.52	8.29	12.324	9.110
.90	.329	.239	6.65	7.47	10.468	7.868
.95	.345	.214	6.32	6.82	9.531	6.873
1.00	.332	.238	5.83	6.23	8.708	6.279
1.10	.328	.225	4.82	5.37	6.973	5.154
1.20	.318	.205	4.29	4.82	6.096	4.494
1.30	.329	.239	3.76	4.20	5.278	3.946
1.40	.310	.209	3.47	3.98	4.833	3.626
1.50	.330	.198	3.11	3.60	4.235	3.265
1.60	.337	.200	2.72	3.04	3.665	2.697
1.70	.352	.177	2.67	3.01	3.542	2.671
1.80	.350	.188	2.58	2.93	3.384	2.613
1.90	.352	.193	2.19	2.48	2.891	2.206
2.00	.341	.183	2.15	2.46	2.839	2.173
2.10	.344	.171	2.11	2.43	2.770	2.140
2.20	.302	.185	1.99	2.32	2.680	2.088
2.30	.325	.168	1.96	2.23	2.594	1.982
2.40	.333	.173	1.60	1.76	2.156	1.558
2.50	.363	.159	1.57	1.73	2.067	1.514
2.80	.341	.133	1.49	1.59	1.985	1.408
3.00	.322	.132	1.45	1.52	1.953	1.362
3.30	.299	.124	1.39	1.46	1.866	1.322
3.60	.367	.145	1.00	1.00	1.348	.908
3.90	.365	.144	1.00	1.00	1.340	.901
4.30	.307	.118	1.00	1.00	1.374	.919
4.60	.301	.106	1.00	1.00	1.372	.917
5.70	.205	.079	1.00	1.00	1.407	.923

ACCELERATED TESTS WITH REPLACEMENT
MONTE CARLC SIZE = 1000
INPUT ALPHA= .300 INPUT BETA= .300
MULTIPLICATICN FACTOR= 2.00 NSTAND= 2

K	ALPHA	BETA	N(0)	N(1)	T(0)	T(1)
.50	.305	.254	18.18	19.57	24.700	17.600
.52	.324	.296	17.12	18.07	21.222	15.943
.54	.325	.275	15.94	17.80	18.763	14.531
.56	.333	.260	15.12	16.35	16.819	12.604
.58	.335	.245	13.73	15.24	14.841	11.000
.60	.317	.281	13.04	14.18	13.528	10.118
.63	.325	.222	12.57	13.33	12.451	8.635
.65	.328	.239	11.66	13.05	11.003	8.308
.68	.310	.302	10.54	12.29	9.779	8.006
.70	.336	.243	10.12	10.98	8.959	6.533
.73	.328	.260	9.82	10.76	8.525	6.391
.75	.326	.249	9.15	9.96	7.725	5.703
.80	.313	.246	8.28	9.04	6.809	4.966
.85	.329	.219	7.19	8.09	5.714	4.186
.90	.337	.242	6.66	7.42	5.125	3.823
.95	.342	.233	6.25	6.77	4.714	3.436
1.00	.300	.239	5.59	6.37	4.307	3.216
1.10	.340	.236	4.80	5.41	3.524	2.671
1.20	.362	.215	4.39	4.77	3.185	2.300
1.30	.340	.223	3.71	4.16	2.731	2.010
1.40	.342	.225	3.55	3.96	2.596	1.941
1.50	.351	.210	3.16	3.57	2.343	1.725
1.60	.366	.197	2.75	3.11	2.047	1.513
1.70	.320	.166	2.59	3.00	2.013	1.442
1.80	.306	.179	2.55	2.94	2.000	1.459
1.90	.352	.207	2.19	2.52	1.728	1.283
2.00	.345	.196	2.20	2.45	1.742	1.242
2.10	.323	.213	2.11	2.42	1.710	1.265
2.20	.306	.172	2.04	2.31	1.700	1.183
2.30	.323	.140	2.00	2.21	1.640	1.123
2.40	.329	.161	1.58	1.78	1.383	.937
2.50	.349	.155	1.57	1.72	1.362	.918
2.80	.317	.142	1.47	1.60	1.325	.879
3.00	.311	.141	1.42	1.51	1.312	.847
3.30	.309	.126	1.36	1.44	1.294	.836
3.60	.367	.150	1.00	1.00	1.119	.750
3.90	.323	.127	1.00	1.00	1.146	.757
4.30	.308	.114	1.00	1.00	1.161	.772
4.60	.275	.098	1.00	1.00	1.189	.784
5.70	.212	.076	1.00	1.00	1.234	.818

ACCELERATED TESTS WITH REPLACEMENT
MONTE CARLO SIZE = 1000
INPUT ALPHA= .300 INPUT BETA= .300
MULTIPLICATION FACTOR= 2.00 NSTAND= 3

K	ALPHA	BETA	N(0)	N(1)	T(0)	T(1)
.50	.303	.254	18.11	20.00	14.874	11.085
.52	.329	.295	17.13	18.39	12.879	9.932
.54	.328	.265	15.81	17.55	11.286	8.818
.56	.334	.257	14.55	16.13	9.922	7.648
.58	.326	.256	14.38	15.14	9.408	6.925
.60	.308	.259	13.12	14.27	8.502	6.242
.63	.345	.248	12.40	13.31	7.416	5.582
.65	.324	.281	11.91	12.71	7.039	5.363
.68	.308	.242	10.92	11.91	6.388	4.661
.70	.322	.243	10.27	11.45	5.826	4.375
.73	.319	.242	9.80	10.81	5.380	4.050
.75	.303	.244	9.29	9.99	5.109	3.682
.80	.352	.234	8.48	9.15	4.327	3.239
.85	.343	.257	7.45	8.09	3.798	2.831
.90	.320	.252	6.57	7.69	3.464	2.648
.95	.323	.210	6.23	6.99	3.143	2.298
1.00	.346	.220	5.76	6.42	2.841	2.134
1.10	.333	.228	4.67	5.46	2.388	1.811
1.20	.351	.202	4.29	4.89	2.141	1.611
1.30	.323	.214	3.70	4.25	1.901	1.421
1.40	.339	.195	3.59	4.00	1.870	1.337
1.50	.325	.216	3.13	3.60	1.695	1.267
1.60	.343	.199	2.70	3.08	1.497	1.083
1.70	.316	.176	2.65	3.00	1.512	1.072
1.80	.317	.163	2.50	2.88	1.459	1.021
1.90	.344	.209	2.20	2.51	1.325	.957
2.00	.325	.176	2.13	2.45	1.329	.937
2.10	.295	.197	2.07	2.39	1.318	.937
2.20	.330	.168	2.04	2.29	1.294	.902
2.30	.292	.165	1.96	2.24	1.300	.890
2.40	.345	.165	1.62	1.74	1.147	.758
2.50	.340	.165	1.55	1.70	1.117	.743
2.80	.356	.137	1.48	1.60	1.098	.727
3.00	.333	.122	1.44	1.53	1.117	.718
3.30	.302	.106	1.38	1.48	1.114	.734
3.60	.385	.183	1.00	1.00	.987	.678
3.90	.321	.131	1.00	1.00	1.042	.679
4.30	.307	.139	1.00	1.00	1.053	.714
4.60	.278	.115	1.00	1.00	1.090	.714
5.70	.226	.086	1.00	1.00	1.146	.765

ACCELERATED TESTS WITH REPLACEMENT
MONTE CARLO SIZE = 1000
INPUT ALPHA= .300 INPUT BETA= .300
MULTIPLICATION FACTOR= 2.00 NSTAND= 5

K	ALPHA	BETA	N(0)	N(1)	T(0)	T(1)
.50	.299	.254	18.12	19.76	7.595	5.699
.52	.328	.278	17.32	18.10	6.764	5.033
.54	.296	.273	15.74	17.52	5.980	4.697
.56	.326	.260	15.44	16.21	5.528	4.100
.58	.325	.277	14.22	14.96	4.995	3.722
.60	.309	.226	13.82	14.44	4.755	3.328
.63	.327	.296	12.51	13.80	4.134	3.291
.65	.324	.255	11.67	12.77	3.764	2.860
.68	.332	.262	10.74	11.82	3.339	2.616
.70	.339	.259	10.37	11.30	3.146	2.436
.73	.343	.254	9.69	10.55	2.907	2.215
.75	.343	.251	9.16	10.12	2.745	2.093
.80	.315	.238	8.13	9.26	2.449	1.869
.85	.340	.230	7.28	7.88	2.153	1.556
.90	.323	.227	6.85	7.65	2.039	1.517
.95	.308	.236	6.19	6.91	1.860	1.375
1.00	.322	.231	5.62	6.39	1.694	1.278
1.10	.345	.200	4.87	5.52	1.490	1.114
1.20	.338	.243	4.26	4.76	1.354	1.013
1.30	.329	.221	3.75	4.26	1.259	.926
1.40	.322	.209	3.43	4.04	1.219	.896
1.50	.321	.188	3.12	3.51	1.148	.793
1.60	.348	.192	2.71	3.10	1.034	.751
1.70	.319	.193	2.68	2.91	1.077	.733
1.80	.328	.199	2.53	2.92	1.045	.757
1.90	.339	.189	2.21	2.50	.979	.690
2.00	.305	.171	2.13	2.47	1.001	.693
2.10	.320	.161	2.12	2.41	1.007	.688
2.20	.282	.186	1.99	2.31	1.009	.690
2.30	.325	.147	1.93	2.21	.976	.660
2.40	.354	.169	1.58	1.75	.885	.593
2.50	.380	.159	1.55	1.72	.874	.593
2.80	.330	.144	1.48	1.59	.917	.593
3.00	.320	.130	1.42	1.54	.913	.609
3.30	.296	.106	1.37	1.48	.950	.618
3.60	.382	.134	1.00	1.00	.863	.568
3.90	.328	.158	1.00	1.00	.898	.606
4.30	.325	.108	1.00	1.00	.935	.632
4.60	.285	.100	1.00	1.00	.966	.641
5.70	.203	.066	1.00	1.00	1.055	.700

Appendix H

<u>Test Plans for Weibull SPRT's</u>

<u>with Designated Risks of .30</u>

K,SHAPE = .5000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .300 INPUT BETA= .300
E(N) = 17.62529 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	5.722	0.000
2	6.827	0.000
3	7.932	0.000
4	9.036	0.000
5	10.141	.907
6	11.246	2.011
7	12.351	3.116
8	13.456	4.221
9	14.560	5.326
10	15.665	6.431
11	16.770	7.535
12	17.875	8.640
13	18.980	9.745
14	20.084	10.850
15	21.189	11.954
16	22.294	13.059
17	23.399	14.164
18	24.504	15.269
19	25.608	16.374
20	26.713	17.478
21	27.818	18.583
22	28.923	19.688
23	30.027	20.793
24	31.132	21.898
25	32.237	23.002
26	33.342	24.107
27	34.447	25.212
28	35.551	26.317
29	36.656	27.422
30	37.761	28.526
31	38.866	29.631
32	39.772	30.736
33	39.772	31.841
34	39.772	32.945
35	39.772	34.050
36	39.772	35.155

TEST IV-2

K,SHAPE = .5200 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .300 INPUT BETA= .300
E(N) = 16.33818 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	5.566	0.000
2	6.675	0.000
3	7.785	0.000
4	8.894	0.000
5	10.003	1.088
6	11.112	2.198
7	12.221	3.307
8	13.330	4.416
9	14.439	5.525
10	15.548	6.634
11	16.658	7.743
12	17.767	8.852
13	18.876	9.961
14	19.985	11.071
15	21.094	12.180
16	22.203	13.289
17	23.312	14.398
18	24.421	15.507
19	25.530	16.616
20	26.640	17.725
21	27.749	18.834
22	28.858	19.944
23	29.967	21.053
24	31.076	22.162
25	32.185	23.271
26	33.294	24.380
27	34.403	25.489
28	35.513	26.598
29	36.601	27.707
30	36.601	28.817
31	36.601	29.926
32	36.601	31.035
33	36.601	32.144

TEST IV-3

K,SHAPE = .5400   DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .300   INPUT BETA= .300
E(N) = 15.18992   E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	5.422	0.000
2	6.536	0.000
3	7.649	0.000
4	8.763	.145
5	9.876	1.258
6	10.990	2.372
7	12.103	3.485
8	13.217	4.599
9	14.330	5.712
10	15.444	6.826
11	16.557	7.939
12	17.671	9.053
13	18.784	10.166
14	19.897	11.280
15	21.011	12.393
16	22.124	13.507
17	23.238	14.620
18	24.351	15.734
19	25.465	16.847
20	26.578	17.960
21	27.692	19.074
22	28.805	20.187
23	29.919	21.301
24	31.032	22.414
25	32.146	23.528
26	33.259	24.641
27	34.373	25.755
28	34.517	26.868
29	34.517	27.982
30	34.517	29.095
31	34.517	30.209

TEST IV-4

K,SHAPE = .5600 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .300 INPUT BETA= .300
E(N) = 14.16113 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	5.289	0.000
2	6.407	0.000
3	7.525	0.000
4	8.643	.300
5	9.760	1.418
6	10.878	2.536
7	11.996	3.653
8	13.114	4.771
9	14.232	5.889
10	15.349	7.007
11	16.467	8.125
12	17.585	9.243
13	18.703	10.360
14	19.821	11.478
15	20.939	12.596
16	22.056	13.714
17	23.174	14.832
18	24.292	15.950
19	25.410	17.067
20	26.528	18.185
21	27.646	19.303
22	28.763	20.421
23	29.881	21.539
24	30.999	22.656
25	32.117	23.774
26	32.417	24.892
27	32.417	26.010
28	32.417	27.128
29	32.417	28.246

K,SHAPE = .5800 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .300 INPUT BETA= .300
E(N) = 13.23571 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	5.165	0.000
2	6.288	0.000
3	7.410	0.000
4	8.532	.446
5	9.654	1.568
6	10.776	2.690
7	11.898	3.812
8	13.021	4.934
9	14.143	6.057
10	15.265	7.179
11	16.387	8.301
12	17.509	9.423
13	18.632	10.545
14	19.754	11.667
15	20.876	12.790
16	21.998	13.912
17	23.120	15.034
18	24.243	16.156
19	25.365	17.278
20	26.487	18.401
21	27.609	19.523
22	28.731	20.645
23	29.854	21.767
24	30.299	22.889
25	30.299	24.012
26	30.299	25.134
27	30.299	26.256

TEST IV-6

K,SHAPE = .6000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .300 INPUT BETA= .300
E(N) = 12.40020 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	5.050	0.000
2	6.177	0.000
3	7.303	0.000
4	8.430	.583
5	9.556	1.709
6	10.683	2.836
7	11.810	3.962
8	12.936	5.089
9	14.063	6.215
10	15.189	7.342
11	16.316	8.469
12	17.442	9.595
13	18.569	10.722
14	19.696	11.848
15	20.822	12.975
16	21.949	14.101
17	23.075	15.228
18	24.202	16.355
19	25.328	17.481
20	26.455	18.608
21	27.582	19.734
22	28.164	20.861
23	28.164	21.987
24	28.164	23.114
25	28.164	24.241

TEST IV-7

K,SHAPE = .6250 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .300 INPUT BETA= .300
E(N) = 11.46513 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	4.917	0.000
2	6.049	0.000
3	7.181	0.000
4	8.313	.743
5	9.445	1.875
6	10.577	3.007
7	11.709	4.139
8	12.841	5.271
9	13.974	6.403
10	15.106	7.536
11	16.238	8.668
12	17.370	9.800
13	18.502	10.932
14	19.634	12.064
15	20.766	13.196
16	21.898	14.328
17	23.030	15.460
18	24.162	16.592
19	25.294	17.724
20	26.037	18.856
21	26.037	19.988
22	26.037	21.120
23	26.037	22.252

TEST IV-8

K,SHAPE = .6500 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .300 INPUT BETA= .300
E(N) = 10.63451 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	4.795	0.000
2	5.932	0.000
3	7.070	0.000
4	8.207	.893
5	9.345	2.031
6	10.482	3.168
7	11.620	4.306
8	12.758	5.443
9	13.895	6.581
10	15.033	7.718
11	16.170	8.856
12	17.308	9.994
13	18.445	11.131
14	19.583	12.269
15	20.721	13.406
16	21.858	14.544
17	22.996	15.681
18	24.133	16.819
19	25.026	17.956
20	25.026	19.094
21	25.026	20.232
22	25.026	21.369

K,SHAPE = .6750 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .300 INPUT BETA= .300
E(N) = 9.89326 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	4.682	0.000
2	5.825	0.000
3	6.968	0.000
4	8.111	1.034
5	9.254	2.177
6	10.397	3.320
7	11.540	4.463
8	12.683	5.606
9	13.827	6.749
10	14.970	7.892
11	16.113	9.035
12	17.256	10.178
13	18.399	11.321
14	19.542	12.464
15	20.685	13.607
16	21.828	14.750
17	22.862	15.894
18	22.862	17.037
19	22.862	18.180
20	22.862	19.323

TEST IV-10

K,SHAPE = .7000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .300 INPUT BETA= .300
E(N) = 9.22894 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	4.578	0.000
2	5.726	0.000
3	6.875	.017
4	8.023	1.166
5	9.172	2.314
6	10.321	3.463
7	11.469	4.611
8	12.618	5.760
9	13.766	5.909
10	14.915	8.057
11	16.064	9.206
12	17.212	10.354
13	18.361	11.503
14	19.510	12.652
15	20.658	13.800
16	21.807	14.949
17	21.824	15.098
18	21.824	17.246
19	21.824	18.395

TEST IV-11

K,SHAPE = .7250 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .300 INPUT BETA= .300
E(N) = 8.63117 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	4.481	0.000
2	5.635	0.000
3	6.789	.136
4	7.943	1.290
5	9.098	2.444
6	10.252	3.598
7	11.406	4.752
8	12.560	5.907
9	13.714	7.061
10	14.868	8.215
11	16.023	9.369
12	17.177	10.523
13	18.331	11.678
14	19.485	12.832
15	20.639	13.986
16	20.775	15.140
17	20.775	16.294
18	20.775	17.448

TEST IV-12

K,SHAPE = .7500 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .300 INPUT BETA= .300
E(N) = 8.09132 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	4.391	0.000
2	5.551	0.000
3	6.711	.248
4	7.870	1.408
5	9.030	2.567
6	10.190	3.727
7	11.350	4.887
8	12.509	6.047
9	13.669	7.206
10	14.829	8.356
11	15.989	9.526
12	17.148	10.686
13	18.308	11.845
14	19.468	13.005
15	19.716	14.165
16	19.716	15.325
17	19.716	16.484

TEST IV-13

K,SHAPE = .8000   DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .300   INPUT BETA= .300
E(N) = 7.15725   E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	4.230	0.000
2	5.401	0.000
3	6.571	.454
4	7.742	1.625
5	8.913	2.796
6	10.084	3.967
7	11.255	5.138
8	12.425	5.309
9	13.597	7.480
10	14.768	8.651
11	15.939	9.822
12	17.110	10.993
13	17.564	12.164
14	17.564	13.335
15	17.564	14.505

TEST IV-14

K,SHAPE = .8500   DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .300   INPUT BETA= .300
E(N) = 6.38063   E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	4.089	0.000
2	5.271	0.000
3	6.453	.640
4	7.635	1.822
5	8.817	3.005
6	10.000	4.187
7	11.182	5.369
8	12.364	6.551
9	13.546	7.733
10	14.728	8.916
11	15.369	10.098
12	15.369	11.280
13	15.369	12.462

TEST IV-15

K,SHAPE = .9000   DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .300   INPUT BETA= .300
E(N) = 5.72772   E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	3.965	0.000
2	5.158	0.000
3	6.352	.809
4	7.545	2.003
5	8.739	3.196
6	9.932	4.390
7	11.126	5.583
8	12.319	6.777
9	13.513	7.971
10	14.322	9.164
11	14.322	10.358
12	14.322	11.551

TEST IV-16

K,SHAPE = .9500   DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .300   INPUT BETA= .300
E(N) = 5.17339   E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	3.855	0.000
2	5.060	0.000
3	6.265	.954
4	7.470	2.159
5	8.675	3.374
6	9.880	4.579
7	11.085	5.784
8	12.290	6.989
9	13.254	8.194
10	13.254	9.399
11	13.254	10.604

TEST IV-17

K,SHAPE =1.0000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .300 INPUT BETA= .300
E(N) = 4.69861 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	3.758	0.000
2	4.975	0.000
3	6.191	1.107
4	7.407	2.324
5	8.624	3.540
6	9.840	4.756
7	11.057	5.973
8	12.164	7.189
9	12.164	8.406
10	12.164	9.622

TEST IV-18

K,SHAPE =1.1000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .300 INPUT BETA= .300
E(N) = 3.93233 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	3.594	0.000
2	4.834	.124
3	6.073	1.364
4	7.313	2.603
5	8.552	3.843
6	9.792	5.082
7	9.916	6.322
8	9.916	7.561

TEST IV-19

K,SHAPE =1.2000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .300 INPUT BETA= .300
E(N) = 3.34581 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	3.462	0.000
2	4.725	.327
3	5.988	1.590
4	7.251	2.852
5	8.514	4.115
6	8.841	5.378
7	8.841	6.641

TEST IV-20

K,SHAPE =1.3000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .300 INPUT BETA= .300
E(N) = 2.88647 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	3.355	0.000
2	4.641	.505
3	5.928	1.792
4	7.215	3.078
5	7.720	4.365
6	7.720	5.651

TEST IV-21

K,SHAPE =1.4000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .300 INPUT BETA= .300
E(N) = 2.51977 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	3.267	0.000
2	4.577	.665
3	5.888	1.975
4	7.198	3.286
5	7.863	4.597
6	7.863	5.907

AD-A034 999 AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OHIO SCH--ETC F/G 12/1
SEQUENTIAL PROBABILITY RATIO TESTS OF THE SCALE PARAMETER BETWE--ETC(U)
DEC 76 J N ROBINSON

UNCLASSIFIED GOR/MA/76D-2 NL

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TEST IV-22

K,SHAPE =1.5000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .300 INPUT BETA= .300
E(N) = 2.22200 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	3.134	0.000
2	4.529	.810
3	5.864	2.145
4	6.674	3.479
5	6.674	4.814

TEST IV-23

K,SHAPE =1.6000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .300 INPUT BETA= .300
E(N) = 1.97683 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	3.134	0.000
2	4.494	.943
3	5.437	2.302
4	5.437	3.662

TEST IV-24

K,SHAPE =1.7000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .300 INPUT BETA= .300
E(N) = 1.77238 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	3.085	0.000
2	4.469	1.067
3	5.536	2.451
4	5.536	3.835

TEST IV-25

K,SHAPE =1.8000   DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .300   INPUT BETA= .300
E(N) = 1.60000   E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	3.045	0.000
2	4.454	1.182
3	5.636	2.591
4	5.636	4.000

TEST IV-26

K,SHAPE =1.9000   DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .300   INPUT BETA= .300
E(N) = 1.45322   E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	3.012	0.000
2	4.303	1.291
3	4.303	2.725

TEST IV-27

K,SHAPE =2.0000   DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .300   INPUT BETA= .300
E(N) = 1.32714   E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	2.985	0.000
2	4.379	1.394
3	4.379	2.854

TEST IV-28

K,SHAPE =2.1000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .300 INPUT BETA= .300
E(N) = 1.21739 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	2.954	.007
2	4.449	1.493
3	4.456	2.978

TEST IV-29

K,SHAPE =2.2000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .300 INPUT BETA= .300
E(N) = 1.12281 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	2.947	.076
2	4.459	1.587
3	4.534	3.099

TEST IV-30

K,SHAPE =2.3000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .300 INPUT BETA= .300
E(N) = 1.03928 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	2.935	.141
2	4.473	1.678
3	4.613	3.216

TEST IV-31

K,SHAPE =2.4000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .300 INPUT BETA= .300
E(N) = .96553 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	2.926	.202
2	3.129	1.767

TEST IV-32

K,SHAPE =2.5000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .300 INPUT BETA= .300
E(N) = .90006 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	2.921	.261
2	3.192	1.852

TEST IV-33

K,SHAPE =2.8000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .300 INPUT BETA= .300
E(N) = .74222 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	2.921	.424
2	3.346	2.097

TEST IV-34

K,SHAPE =3.0000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .300 INPUT BETA= .300
E(N) = .66105 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	2.933	.525
2	3.457	2.253

TEST IV-35

K,SHAPE =3.3000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .300 INPUT BETA= .300
E(N) = .56449 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	2.953	.655
2	3.628	2.479

TEST IV-36

K,SHAPE =3.6000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .300 INPUT BETA= .300
E(N) = .48978 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	1.901	.798

TEST IV-37

K,SHAPE =3.9000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .300 INPUT BETA= .300
E(N) = .43054 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	1.991	.924

TEST IV-38

K,SHAPE =4.3000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .300 INPUT BETA= .300
E(N) = .36903 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	2.113	1.086

TEST IV-39

K,SHAPE =4.6000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .300 INPUT BETA= .300 NMAX= 10
E(N) = .33227 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	2.207	1.204

TEST IV-40

K,SHAPE =5.7000 DISCRIMINATION RATIO= 1.500
INPUT ALPHA= .300 INPUT BETA= .300
E(N) = .24032 E(N) MULTIPLIER = 2.00

TEST	ACCEPT	REJECT
1	2.566	1.625

Appendix I

<u>Three Complete Computer Programs</u>

<u>Used in Thesis Preparation</u>

Case I Simulation

"ONETIME"

```
      PROGRAM ONETIME(INPUT,OUTPUT)
      COMMON THETA,ALPHA,BETA,FACTOR,SHAPE,NSEED,NBOUND
      COMMON NMAX,SUM(2),BOUNDU(500),BOUNDL(500),TIM(2)
      COMMON AC(2),RJ(2),WX(500),XK(500),ALFERR,BETERR
      COMMON TIMAVG,AVG1,AVG2,EN,A1,A2,A3,EXPO
      COMMON NSTAND,TRUNU(2),TZERO,TRUNN(2)
      DIMENSION SHAPIN(40)
      NMAX=1000
177   FORMAT(//////////)
      PRINT 177
      PRINT*," ACCELERATED TESTS WITH REPLACEMENT"
19    FORMAT(" MONTE CARLO SIZE= ",I6)
      PRINT 19,NMAX
      ALPHA=.20
      BETA=.20
      THETA=1.5
      DATA SHAPIN/.50,.52,.54,.56,.58,.60,.625,.65,
     1.675,.7,.725,.75,.8,.85,.9,.95,
     21.0,1.1,1.2,1.3,1.4,1.5,1.6,1.7,
     31.8,1.9,2.0,2.1,2.2,2.3,2.4,2.5,
     42.8,3.0,3.3,3.6,3.9,4.3,4.6,5.7/
12    FORMAT(" INPUT ALPHA= ",F6.3," INPUT BETA= ",F6.3)
      PRINT 12,ALPHA,BETA
      FACTOR=2.0
      NSEED=5
      NSTAND=1
13    FORMAT(" MULTIPLICATION FACTOR= ",F5.2," NSTAND= ",I2)
      PRINT 13,FACTOR,NSTAND
14    FORMAT(/)
      PRINT 14
101   FORMAT("  K     ALPHA    BETA   N(0)     N(1)    T(0)     T(1)")
      PRINT 101
      PRINT*,"  "
      CALL RANSET(NSEED)
      DO 20 ISM=1,40
      SHAPE=SHAPIN(ISM)
      EXPO=1./SHAPE
      CALL TABLE
      CALL TESTER
20    CALL PRINT
      STOP
      END
```

```
C*******THIS SECTION RUNS A SPECIFIC TEST
       SUBROUTINE TESTER
       COMMON THETA,ALPHA,BETA,FACTOR,SHAPE,NSEED,NBOUND
       COMMON NMAX,SUM(2),BOUNDU(500),BOUNDL(500),TIM(2)
       COMMON AC(2),RJ(2),WX(500),XK(500),ALFERR,BETERR
       COMMON TIMAVG,AVG1,AVG2,EN,A1,A2,A3,EXPO
       COMMON NSTAND,TRUNU(2),TZERO,TRUNN(2)
       DIMENSION VT(2),NH(2),ANCHR1(50),ANCHR2(50)
       DIMENSION STNTIM(50),CLOCK(50)
       DO 600 INP=1,2
       AC(INP)=.0
       NH(INP)=.0
       TIM(INP)=.0
       TRUNU(INP)=.0
       TRUNN(INP)=.0
       RJ(INP)=.0
       DO 600 MONTE=1,NMAX
       SUM1=.0
       VT(INP)=.0
       DO 610 IK=1,NBOUND
       X=VALU(INP)
       SUM1=SUM1+X
       W=X**SHAPE
       VT(INP)=VT(INP)+W
       IF(VT(INP).GE.TZERO)GO TO 601
       IF(VT(INP).GE.BOUNDU(IK))GO TO 611
       IF(VT(INP).LE.BOUNDL(IK))GO TO 612
       IF(IK.GE.NBOUND)GO TO 612
610    CONTINUE
601    TIME=SUM1
       AC(INP)=AC(INP)+1.
       TRUNU(INP)=TRUNU(INP)+1.
       GO TO 615
611    TIME=SUM1
       AC(INP)=AC(INP)+1.
       GO TO 615
612    TIME=SUM1
       RJ(INP)=RJ(INP)+1.0
       GO TO 615
615    TIM(INP)=TIM(INP)+TIME
       NH(INP)=NH(INP)+IK
600    CONTINUE
       RNMAX=NMAX
       ALFERR=RJ(1)/RNMAX
       BETERR=AC(2)/RNMAX
       TIMAVG=(TIM(1)+TIM(2))/(2*RNMAX)
       AVG1=TIM(1)/RNMAX
       AVG2=TIM(2)/RNMAX
       RH1=NH(1)
       RH2=NH(2)
       A1=RH1/RNMAX
       A2=RH2/RNMAX
       A3=(A1+A2)/2.
       RETURN
       END
```

```
      SUBROUTINE TABLE
      COMMON THETA,ALPHA,BETA,FACTOR,SHAPE,NSEED,NBOUND
      COMMON NMAX,SUM(2),BOUNDU(500),BOUNDL(500),TIM(2)
      COMMON AC(2),RJ(2),WX(500),XK(500),ALFERR,BETERR
      COMMON TIMAVG,AVG1,AVG2,EN,A1,A2,A3,EXPO
      COMMON NSTAND,TRUNU(2),TZERO,TRUNN(2)
C*******CREATES A TEST SCHEME/TABLE FOR GIVEN INPUTS
      D=1.-(1./THETA**SHAPE)
      B=BETA/(1.-ALPHA)
      A=(1.-BETA)/ALPHA
      H1=(-ALOG(B))/D
      H2=ALOG(A)/D
      S=(SHAPE*ALOG(THETA))/D
      EN=(H2-BETA*(H1+H2))/(S-1.)
      NBOUND=FACTOR*EN+1
      TZERO=NBOUND*S
      DO 501 IN=1,NBOUND
      BOUNDU(IN)=IN*S+H1
      BOUNDL(IN)=IN*S-H2
      IF(BOUNDU(IN).GE.TZERO)BOUNDU(IN)=TZERO
      IF(BOUNDL(IN).LE..0)BOUNDL(IN)=.0
501   CONTINUE
      RETURN
      END
```

```
      FUNCTION VALU(INP)
      COMMON THETA,ALPHA,BETA,FACTOR,SHAPE,NSEED,NBOUND
      COMMON NMAX,SUM(2),BOUNDU(500),BOUNDL(500),TIM(2)
      COMMON AC(2),RJ(2),WX(500),XK(500),ALFERR,BETERR
      COMMON TIMAVG,AVG1,AVG2,EN,A1,A2,A3,EXPO
      COMMON NSTAND,TRUNU(2),TZERO,TRUNN(2)
      EXPO=1/SHAPE
      UNIVAL=1.-RANF(1)
      ALOGUN=ALOG(UNIVAL)
      ABSOLU=ABS(ALOGUN)
      IF(INP.EQ.1)XVAL=THETA*ABSOLU**EXPO
      IF(INP.EQ.2)XVAL=ABSOLU**EXPO
      VALU=XVAL
      RETURN
      END
```

```
C******PRINT IS A COMPOSIT SUBROUTINE THAT PRINTS
C******OUT DESIRED STATISTICS IN READABLE FORM
C******TABLES FOR STANDARD TESTS ARE INCLUDED
      SUBROUTINE PRINT
      COMMON THETA,ALPHA,BETA,FACTOR,SHAPE,NSEED,NBOUND
      COMMON NMAX,SUM(2),BOUNDU(500),BOUNDL(500),TIM(2)
      COMMON AC(2),RJ(2),WX(500),XK(500),ALFERR,BETERR
      COMMON TIMAVG,AVG1,AVG2,EN,A1,A2,A3,EXPO
      COMMON NSTAND,TRUNU(2),TZERO,TRUNN(2)
100   FORMAT(1H ,F4.2,2(2X,F6.3),2(2X,F6.2),2(2X,F7.3))
      PRINT 100,SHAPE,ALFERR,BETERR,A1,A2,AVG1,AVG2
      RETURN
      END
```

Case II Simulation

"NONREP"

```
      PROGRAM NONPEP(INPUT,OUTPUT)
      COMMON THETA,ALPHA,BETA,FACTOR,SHAPE,NSEED,NBOUND
      COMMON NMAX,SUM(2),BOUNDU(500),BOUNDL(500),TIM(2)
      COMMON AC(2),RJ(2),WX(500),XK(500),ALFERR,BETERR
      COMMON TIMAVG,AVG1,AVG2,EN,A1,A2,A3,EXPO
      COMMON TRUNU(2),TZERO,TRUNN(2)
      DIMENSION SHAPIN(40)
      PRINT*," ******WEIBULL S.P.R.T.*********"
      THETA=1.5
      ALPHA=.30
      BETA=.30
      DATA SHAPIN/.50,.52,.54,.56,.58,.60,.625,.65,
     1.575,.7,.725,.75,.8,.85,.9,.95,
     21.0,1.1,1.2,1.3,1.4,1.5,1.6,1.7,
     31.8,1.9,2.0,2.1,2.2,2.3,2.4,2.5,
     42.8,3.0,3.3,3.6,3.9,4.3,4.6,5.7/
12    FORMAT(" INPUT ALPHA= ",F5.3," INPUT BETA= ",F5.3)
      PRINT 12,ALPHA,BETA
14    FORMAT(/)
      PRINT 14
      FACTOR=3.0
13    FORMAT(" MULTIPLICATION FACTOR= ",F5.2)
      PRINT 13,FACTOR
      NSEED=5
      NMAX=10
      CALL RANSET(NSEED)
10    FORMAT(6F5.2,2I3)
      DO 20 IST=1,40
      SHAPE=SHAPIN(IST)
      PRINT 333
333   FORMAT(////////////////////)
      PRINT*,"                                            TEST IV-",IST
      PRINT*,"        "
      EXPO=1./SHAPE
      CALL TABLE
      CALL TESTER
20    CALL PRINT
      STOP
      END
```

```
      SUBROUTINE TABLE
      COMMON THETA,ALPHA,BETA,FACTOR,SHAPE,NSEED,NBOUND
      COMMON NMAX,SUM(2),BOUNDU(500),BOUNDL(500),TIM(2)
      COMMON AC(2),RJ(2),WX(500),XK(500),ALFERR,BETERR
      COMMON TIMAVG,AVG1,AVG2,EN,A1,A2,A3,EXPO
      COMMON TRUNU(2),TZERO,TRUNN(2)
C*******CREATES A TEST SCHEME/TABLE FOR GIVEN INPUTS
      D=1.-(1./THETA**SHAPE)
      B=BETA/(1.-ALPHA)
      A=(1.-BETA)/ALPHA
      H1=(-ALOG(B))/D
      H2=ALOG(A)/D
      S=(SHAPE*ALOG(THETA))/D
      EN=(H2-BETA*(H1+H2))/(S-1.)
      NBOUND=FACTOR*EN+1
      TZERO=NBOUND*S
      DO 501 IN=1,NBOUND
      BOUNDU(IN)=IN*S+H1
      BOUNDL(IN)=IN*S-H2
      IF(BOUNDU(IN).GE.TZERO)BOUNDU(IN)=TZERO
      IF(BOUNDL(IN).LE..0)BOUNDL(IN)=.0
501   CONTINUE
      RETURN
      END
```

```
C*******THIS SECTION RUNS A SPECIFIC TEST
      SUBROUTINE TESTER
      COMMON THETA,ALPHA,BETA,FACTOR,SHAPE,NSEED,NBOUND
      COMMON NMAX,SUM(2),BOUNDU(500),BOUNDL(500),TIM(2)
      COMMON AC(2),RJ(2),WX(500),XK(500),ALFERR,BETERR
      COMMON TIMAVG,AVG1,AVG2,EN,A1,A2,A3,EXPO
      COMMON TRUNU(2),TZERO,TRUNN(2)
      DIMENSION VT(2),NH(2)
      RNMAX=NMAX
      DO 500 INP=1,2
      AC(INP)=.0
      NH(INP)=.0
      TIM(INP)=.0
      TRUNU(INP)=.0
      TRUNN(INP)=.0
      RJ(INP)=.0
      DO 500 MONTE=1,NMAX
      CALL VALUS(INP)
      SUM(INP)=.0
      VT(INP)=.0
      SAVE=.0
      DO 510 IK=1,NBOUND
      XK(IK)=WX(IK)**SHAPE
      SUM(INP)=SUM(INP)+XK(IK)
      VT(INP)=SUM(INP)+(NBOUND-IK)*XK(IK)
      IF(VT(INP).GE.TZERO)GO TO 601
```

```
      IF(VT(INP).GE.BOUNDU(IK))GO TO 611
      IF(IK.GE.NBOUND)TRUNN(INP)=TRUNN(INP)+1.
      IF(IK.GE.NBOUND)GO TO 612
      IF(VT(INP).LE.BOUNDL(IK))GO TO 612
      SAVE=VT(INP)
610   CONTINUE
601   TIME=((TZERO-VT(INP))/(NBOUND-IK+1)+XK(IK))**EXPO
      AC(INP)=AC(INP)+1.
      TRUNU(INP)=TRUNU(INP)+1.
      GO TO 615
611   TIME=((BOUNDU(IK)-SAVE)/(NBOUND-IK+1)+XK(IK))**EXPO
      AC(INP)=AC(INP)+1.
      GO TO 615
612   TIME=WX(IK)
      RJ(INP)=RJ(INP)+1.0
      GO TO 615
615   TIM(INP)=TIM(INP)+TIME
      NH(INP)=NH(INP)+IK
600   CONTINUE
      ALFERR=RJ(1)/RNMAX
      BETERR=AC(2)/RNMAX
      TIMAVG=(TIM(1)+TIM(2))/(2*RNMAX)
      AVG1=TIM(1)/RNMAX
      AVG2=TIM(2)/RNMAX
      RNH1=NH(1)
      RNH2=NH(2)
      A1=RNH1/RNMAX
      A2=RNH2/RNMAX
      A3=(A1+A2)/2.
      RETURN
      END
```

```
      SUBROUTINE VALUS(INP)
      COMMON THETA,ALPHA,BETA,FACTOR,SHAPE,NSEED,NBOUND
      COMMON NMAX,SUM(2),BOUNDU(500),BOUNDL(500),TIM(2)
      COMMON AC(2),RJ(2),WX(500),XK(500),ALFERR,BETERR
      COMMON TIMAVG,AVG1,AVG2,EN,A1,A2,A3,EXPO
      COMMON TRUNU(2),TZERO,TRUNN(2)
      EXPO=1/SHAPE
      DO 400 IRAN=1,NBOUND
      UNIVAL=1.-RANF(1)
      ALOGUN=ALOG(UNIVAL)
      ABSOLU=ABS(ALOGUN)
      IF(INP.EQ.1)XVAL=THETA*ABSOLU**EXPO
      IF(INP.EQ.2)XVAL=ABSOLU**EXPO
      WX(IRAN)=XVAL
400   CONTINUE
      CALL SORTW(WX,NBOUND)
      RETURN
      END
```

```
C******PRINT IS A COMPOSIT SUBROUTINE THAT PRINTS
C******OUT DESIRED STATISTICS IN READABLE FORM
C******TABLES FOR STANDARD TESTS ARE INCLUDED
      SUBROUTINE PRINT
      COMMON THETA,ALPHA,BETA,FACTOR,SHAPE,NSEED,NBOUND
      COMMON NMAX,SUM(2),BOUNDU(500),BOUNDL(500),TIM(2)
      COMMON AC(2),RJ(2),WX(500),XK(500),ALFERR,BETERR
      COMMON TIMAVG,AVG1,AVG2,EN,A1,A2,A3,EXPO
      COMMON TRUNU(2),TZERO,TRUNN(2)
127   FORMAT(////////////////////////////////////////)
102   FORMAT(" K,SHAPE =",F6.4,"       DISCRIMINATION RATIO= ",F6.3)
103   FORMAT(" E(N)      =",F10.5,"  E(N) MULTIPLIER = ",F5.2)
105   FORMAT(" SAMPLE SIZE ON TEST=",I4)
106   FORMAT("   TEST     ACCEPT       REJECT      TEST     ACCEPT       REJE
     1CT")
107   FORMAT("  TEST      ACCEPT      REJECT")
108   FORMAT(1H ,I4,2(5X,F7.3),3X,I4,2(5X,F7.3))
109   FORMAT(1H ,I4,2(5X,F7.3))
110   FORMAT(" PRESENT TABLE DIMENSIONS PRECLUDE THIS SIZE")
115   FORMAT(1H ,"INPUT ALPHA= ",F5.3,"   INPUT BETA= ",F5.3,
     1"    NMAX= ",I5)
116   FORMAT(1H ,"TIME AVERAGE FOR BOTH=",F8.4)
100   FORMAT(" ALPHA(EST)= ",F8.5," BETA(EST)= ",F8.5)
101   FORMAT(" TIM AV(0)= ",F8.5," TIM AV(1)= ",F8.5,
     1"  TIME AVG(2)= ",F8.5)
126   FORMAT(" N(0)= ",F8.3," N(1)= ",F8.3," N(AV)= ",F8.3)
128   FORMAT(" TU0=",F6.2," TN0=",F6.2," TU1=",F6.2," TN1=",F6.2)
      PRINT 102,SHAPE,THETA
      PRINT 115,ALPHA,BETA,NMAX
      PRINT 103,EN,FACTOR
888   FORMAT(/)
      PRINT 888
      IF(NBOUND.GT.315)GO TO 207
      IF(NBOUND.LE.45)GO TO 201
      IF(NBOUND.LE.90)GO TO 202
      IF(NBOUND.LE.135)GO TO 203
      IF(NBOUND.LE.180)GO TO 204
      IF(NBOUND.LE.225)GO TO 205
      IF(NBOUND.LE.270)GO TO 206
      IF(NBOUND.LE.315)GO TO 206
201   PRINT 107
```

```
      DO 301 I1=1,NBOUND
301   PRINT 109,I1,BOUNDU(I1),BOUNDL(I1)
      GO TO 999
202   PRINT 106
      DO 302 I2=1,45
      J2=I2+45
      IF(J2.GT.NBOUND)GO TO 312
      PRINT 108,I2,BOUNDU(I2),BOUNDL(I2),J2,BOUNDU(J2),BOUNDL(J2)
      GO TO 302
312   PRINT 109,I2,BOUNDU(I2),BOUNDL(I2)
302   CONTINUE
      GO TO 999
203   PRINT 106
      DO 303 I3=1,45
      J3=I3+45
      PRINT 108,I3,BOUNDU(I3),BOUNDL(I3),J3,BOUNDU(J3),BOUNDL(J3)
303   CONTINUE
      PRINT 127
      PRINT 107
      DO 313 I3=91,NBOUND
313   PRINT 109,I3,BOUNDU(I3),BOUNDL(I3)
      GO TO 999
204   PRINT 106
      DO 304 I4=1,45
      J4=I4+45
304   PRINT 108,I4,BOUNDU(I4),BOUNDL(I4),J4,BOUNDU(J4),BOUNDL(J4)
      PRINT 127
      PRINT 106
      DO 314 I4=91,135
      J4=I4+45
      IF(J4.GT.NBOUND)GO TO 324
      PRINT 108,I4,BOUNDU(I4),BOUNDL(I4),J4,BOUNDU(J4),BOUNDL(J4)
      GO TO 314
324   PRINT 109,I4,BOUNDU(I4),BOUNDL(I4)
314   CONTINUE
      GO TO 999
205   PRINT 106
      DO 305 I5=1,45
      J5=I5+45
305   PRINT 108,I5,BOUNDU(I5),BOUNDL(I5),J5,BOUNDU(J5),BOUNDL(J5)
      PRINT 127
      PRINT 106
      DO 315 I5=91,135
      J5=I5+45
315   PRINT 108,I5,BOUNDU(I5),BOUNDL(I5),J5,BOUNDU(J5),BOUNDL(J5)
      PRINT 127
      PRINT 107
      DO 325 I5=181,NBOUND
```

```
325   PRINT 109,I5,BOUNDU(I5),BOUNDL(I5)
      PRINT 127
      GO TO 999
206   PRINT 106
      DO 316 I6=1,45
      J6=I6+45
316   PRINT 108,I6,BOUNDU(I6),BOUNDL(I6),J6,BOUNDU(J6),BOUNDL(J6)
      PRINT 127
      PRINT 106
      DO 326 I6=91,135
      J6=I6+45
326   PRINT 108,I6,BOUNDU(I6),BOUNDL(I6),J6,BOUNDU(J6),BOUNDL(J6)
      PRINT 127
      PRINT 106
      DO 356 I6=181,225
      J6=I6+45
      IF(J6.GT.NBOUND)GO TO 346
      PRINT 108,I6,BOUNDU(I6),BOUNDL(I6),J6,BOUNDU(J6),BOUNDL(J6)
      GO TO 356
346   PRINT 109,I6,BOUNDU(I6),BOUNDL(I6)
356   CONTINUE
      IF(NBOUND.LT.270)GO TO 999
      PRINT 127
      PRINT 107
      DO 366 I7=271,NBOUND
366   PRINT 109,I7,BOUNDU(I7),BOUNDL(I7)
      GO TO 999
207   PRINT 110
      GO TO 999
999   CONTINUE
      PRINT 127
      RETURN
      END
```

Case III Simulation

"RPLTABS"

```
      PROGRAM RPLTABS(INPUT,OUTPUT)
      COMMON THETA,ALPHA,BETA,FACTOR,SHAPE,NSEED,NBOUND
      COMMON NMAX,SUM(2),BOUNDU(500),BOUNDL(500),TIM(2)
      COMMON AC(2),RJ(2),WX(500),XK(500),ALFERR,BETERR
      COMMON TIMAVG,AVG1,AVG2,EN,A1,A2,A3,EXPO
      COMMON NSTAND,TRUNU(2),TZERO,TRUNN(2)
      DIMENSION SHAPIN(10)
11    FORMAT(////////////)
      PRINT 11
C    NMAX INDICATES THE MONTE CARLO SIZE
      NMAX=5000
      PRINT*," ACCELERATED TESTS WITH REPLACEMENT"
19    FORMAT(" MONTE CARLO SIZE = ",I6)
      PRINT 19,NMAX
      ALPHA=.10
      BETA=.10
      THETA=1.5
      DATA SHAPIN/.50,1.0,1.3,1.6,2.0,2.2,2.5,3.3,4.3,5.7/
12    FORMAT(" INPUT ALPHA= ",F6.3," INPUT BETA= ",F6.3)
      PRINT 12,ALPHA,BETA
      FACTOR=2.0
      NSEED=5
      NSTAND=2
13    FORMAT(" MULTIPLICATION FACTOR= ",F5.2," NSTAND= ",I2)
      PRINT 13,FACTOR,NSTAND
14    FORMAT(/)
      PRINT 14
101   FORMAT("  K     ALPHA    BETA   N(0)     N(1)    T(0)     T(1)")
      PRINT 101
      PRINT*,"  "
      CALL RANSET(NSEED)
      DO 20 ISM=1,10
      SHAPE=SHAPIN(ISM)
      EXPO=1./SHAPE
      CALL TABLE
      CALL TESTER
20    CALL PRINT
      PRINT 11
      STOP
      END
```

```
      SUBROUTINE TABLE
      COMMON THETA,ALPHA,BETA,FACTOR,SHAPE,NSEED,NBOUND
      COMMON NMAX,SUM(2),BOUNDU(500),BOUNDL(500),TIM(2)
      COMMON AC(2),RJ(2),WX(500),XK(500),ALFERR,BETERR
      COMMON TIMAVG,AVG1,AVG2,EN,A1,A2,A3,EXPO
      COMMON NSTAND,TRUNU(2),TZERO,TRUNN(2)
C*******CREATES A TEST SCHEME/TABLE FOR GIVEN INPUTS
      D=1.-(1./THETA**SHAPE)
      B=BETA/(1.-ALPHA)
      A=(1.-BETA)/ALPHA
      H1=(-ALOG(B))/D
      H2=ALOG(A)/D
      S=(SHAPE*ALOG(THETA))/D
      EN=(H2-BETA*(H1+H2))/(S-1.)
      NBOUND=FACTOR*EN+1
      TZERO=NBOUND*S
      DO 501 IN=1,NBOUND
      BOUNDU(IN)=IN*S+H1
      BOUNDL(IN)=IN*S-H2
      IF(BOUNDU(IN).GE.TZERO)BOUNDU(IN)=TZERO
      IF(BOUNDL(IN).LE..0)BOUNDL(IN)=.0
  501 CONTINUE
      RETURN
      END
```

```
C*******THIS SECTION RUNS A SPECIFIC TEST
      SUBROUTINE TESTER
      COMMON THETA,ALPHA,BETA,FACTCR,SHAPE,NSEED,NBOUND
      COMMON NMAX,SUM(2),BOUNDU(500),BOUNDL(500),TIM(2)
      COMMON AC(2),RJ(2),WX(500),XK(500),ALFERR,BETERR
      COMMON TIMAVG,AVG1,AVG2,EN,A1,A2,A3,EXPO
      COMMON NSTAND,TRUNU(2),TZERO,TRUNN(2)
      DIMENSION VT(2),NH(2),ANCHR1(50),ANCHR2(50)
      DIMENSION STNTIM(50),CLOCK(50)
      DO 600 INP=1,2
      AC(INP)=.0
      NH(INP)=.0
      TIM(INP)=.0
      TRUNU(INP)=.0
      TRUNN(INP)=.0
      RJ(INP)=.0
      DO 600 MONTE=1,NMAX
      SUM1=.0
      VT(INP)=.0
      DO 40 IST=1,NSTAND
      ANCHR1(IST)=.0
      ANCHR2(IST)=.0
      STNTIM(IST)=.0
      CLOCK(IST)=0.
40    CONTINUE
      DO 50 IST=1,NSTAND
      STNTIM(IST)=VALU(INP)
50    CLOCK(IST)=STNTIM(IST)
      DO 610 IK=1,NBOUND
      MIN=1
      DO 603 IST=2,NSTAND
      IF(STNTIM(IST).LT.STNTIM(MIN))MIN=IST
603   CONTINUE
```

```
      ANCHR1(MIN)=ANCHR1(MIN)+(CLOCK(MIN))**SHAPE
      ANCHR2(MIN)=ANCHR2(MIN)+CLOCK(MIN)
      SUM1=SUM1+(CLOCK(MIN))**SHAPE
      SUM2=.0
      DO 606 IST=1,NSTAND
      IF(IST.EQ.MIN)GO TO 606
      SUM2=SUM2+(STNTIM(MIN)-ANCHR2(IST))**SHAPE
606   CONTINUE
      VT(INP)=SUM1+SUM2
      IF(VT(INP).GE.TZERO)GO TO 601
      IF(VT(INP).GE.BOUNDU(IK))GO TO 611
      IF(VT(INP).LE.BOUNDL(IK))GO TO 612
      IF(IK.GE.NBOUND)GO TO 612
      TNEXT=VALU(INP)
      STNTIM(MIN)=STNTIM(MIN)+TNEXT
      CLOCK(MIN)=TNEXT
610   CONTINUE
601   TIME=STNTIM(MIN)
      AC(INP)=AC(INP)+1.
      TRUNU(INP)=TRUNU(INP)+1.
      GO TO 615
611   TIME=STNTIM(MIN)
      AC(INP)=AC(INP)+1.
      GO TO 615
612   TIME=STNTIM(MIN)
      RJ(INP)=RJ(INP)+1.0
      GO TO 615
615   TIM(INP)=TIM(INP)+TIME
      NH(INP)=NH(INP)+IK
600   CONTINUE
      RNMAX=NMAX
      ALFERR=RJ(1)/RNMAX
      BETERR=AC(2)/RNMAX
      TIMAVG=(TIM(1)+TIM(2))/(2*RNMAX)
      AVG1=TIM(1)/RNMAX
      AVG2=TIM(2)/RNMAX
      RH1=NH(1)
      RH2=NH(2)
      A1=RH1/RNMAX
      A2=RH2/RNMAX
      A3=(A1+A2)/2.
      RETURN
      END
```

```
      FUNCTION VALU(INP)
      COMMON THETA,ALPHA,BETA,FACTOR,SHAPE,NSEED,NBOUND
      COMMON NMAX,SUM(2),BOUNDU(500),BOUNDL(500),TIM(2)
      COMMON AC(2),RJ(2),WX(500),XK(500),ALFERR,BETERR
      COMMON TIMAVG,AVG1,AVG2,EN,A1,A2,A3,EXPO
      COMMON NSTAND,TRUNU(2),TZERO,TRUNN(2)
      EXPO=1/SHAPE
      UNIVAL=1.-RANF(1)
      ALOGUN=ALOG(UNIVAL)
      ABSOLU=ABS(ALOGUN)
      IF(INP.EQ.1)XVAL=THETA*ABSOLU**EXPO
      IF(INP.EQ.2)XVAL=ABSOLU**EXPO
      VALU=XVAL
      RETURN
      END
```

```
C******PRINT IS A COMPOSIT SUBROUTINE THAT PRINTS
C******OUT DESIRED STATISTICS IN READABLE FORM
C******TABLES FOR STANDARD TESTS ARE INCLUDED
      SUBROUTINE PRINT
      COMMON THETA,ALPHA,BETA,FACTOR,SHAPE,NSEED,NBOUND
      COMMON NMAX,SUM(2),BOUNDU(500),BOUNDL(500),TIM(2)
      COMMON AC(2),RJ(2),WX(500),XK(500),ALFERR,BETERR
      COMMON TIMAVG,AVG1,AVG2,EN,A1,A2,A3,EXPO
      COMMON NSTAND,TRUNU(2),TZERO,TRUNN(2)
100   FORMAT(1H ,F4.2,2(2X,F6.3),2(2X,F6.2),2(2X,F7.3))
      PRINT 100,SHAPE,ALFERR,BETERR,A1,A2,AVG1,AVG2
      RETURN
      END
```

Vita

James Norris Robinson was born on 23 August 1947 in Hartford, Connecticut. He graduated from high school in Newington, Connecticut in 1965 and attended the United States Air Force Academy from which he received a degree of Bachelor of Science in June 1969. Upon graduation, he received a commission in the USAF. He completed pilot training and received his wings in August 1970. He then served as a KC-135 pilot and wing KC-135 scheduling officer in the 96th Bomb Wing, Dyess AFB, Texas until entering the School of Engineering, Air Force Institute of Technology, in June 1975.

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for the third type. Truncated test plans representing 40 possible shape parameters ranging from .50 to 5.70 are presented for four sets of designated risks. Designated risks for equal Type I and Type II errors are .05, .10, .20, and .30. Monte Carlo computer simulations are used to evaluate the test plans in terms of actual risks and actual expected time and failure number to decision under $H_{(0)}$ and $H_{(A)}$.

Basic equivalence of test configurations is demonstrated in terms of expected true risk and failure number. Increased discrimination capability is also demonstrated as shape parameter values increase.

A cost model which can be used to determine which testing configuration to use under different testing restrictions is offered. Two examples are presented to illustrate application of Weibull SPRT's under cost restraints.